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THIRTY-SECOND

PROGRESS REPORT OF THE FIRESTONE TIRE & RUBBER COMPANY ON 105 MM. BATTALION ANTI-TANK PROJECT

UNDER

Contract No. DA-33-019-ORD-33

ORDNANCE DEPARTMENT PROJECTS

TS4-4020—WEAPONS AND ACCESSORIES

TM1-1540—AMMUNITION

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COPY No. 6

THE FIRESTONE TIRE & RUBBER COMPANY
Defense Research Division
Akron, Ohio

MARCH 1953

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SECURITY INFORMATION

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THIRTY-SECOND

PROGRESS REPORT

OF

THE FIRESTONE TIRE & RUBBER CO.

ON

105 MM BATTALION ANTI-TANK PROJECT

Contract Nos.
DA-33-019-ORD-33 (Negotiated)
DA-33-019-ORD-1202

RAD Nos. ORDTS 1-12383
ORDTS 3-3955
ORDTS 3-3957
ORDTA 3-3952

THE FIRESTONE TIRE & RUBBER CO.
Defense Research Division
Akron, Ohio

MARCH, 1953

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ABSTRACT

An inventory is presented of the recoilless rifles and mounts manufactured by Firestone Defense Research Division for its own research and development activities.

The main revised features of a new T137 rifle are described. The rifle is to be released for manufacture in April.

An aluminum T152E4 mount is being made.

The design of a firing system for the ONTOS vehicle has been completed.

Projectiles of the T138E57 type, for evaluating the effect upon flight behavior of spin rate and center of gravity location, have been manufactured and long range firing tests are being arranged.

The fin-opening piston for the T119 projectile has been redesigned and tested. The piston is illustrated and the test data presented.

A laminated cartridge case liner for the T119 cartridge assembly has been developed and tested. The liners are shown and preliminary test results presented.

An accuracy firing with a revised T119 projectile having fins two inches shorter than normal is reported. Additional tests with short fins are planned.

Data are presented for the penetration-standoff behavior of a 90mm size cone of the DRB398 type.

The effect of standoff on drawn, recoined and machined liners is described. The inspection and penetration data are given.

A program to evaluate the performance of composite or bimetal cones has been completed and the results are presented.

The T267 superquick and delay fuze has been redesigned to improve ease of initiation. The revisions are illustrated and test results described.

Tests conducted with T223E2 mechanical superquick and delay fuzes are reported.

Functioning tests of the DRA726 nose element in T138E57 and T119 E11 HEAT projectiles were conducted at Aberdeen Proving Ground. The tests are summarized.

A summary is presented, listing the items delivered to specified government agencies for their evaluation and use.

THE WEAPON SYSTEM

An inventory of T137 rifles and T152 mounts, manufactured by Firestone Defense Research Division for its own research and development activities, is given in Table I. Additional rifles and mounts, manufactured by Firestone, have been delivered to other installations for their own use and these are recorded in the final section of this report.

Table I

Inventory of Recoilless Rifles and Mounts

Manufactured by Firestone and Used in Research and Development Activities of Defense Research Division

Rifle or Mount	Location	Comments
RIFLES		
T137E3 Rifles		
Serial Nos. 1 & 2	Akron	Returned from Fort Benning
No. 13	Aberdeen Proving Ground	Test Facility
Nos. 21 & 22	Akron	For Spare Parts
T137E2 Rifles		
Serial No. 1	Akron	For Spare Parts
No. 2	Erie Ordnance Depot	Test Facility
T137E1 Rifles		
Serial Nos. 1, 2 & 3	Usable parts removed and remainder scrapped	
No. 4	Watertown Arsenal	Metallurgical Study
Nos. 5, 6, 7	Usable parts removed and remainder scrapped	
No. 8	Akron	Held for historical value
T137 Rifle		
Serial No. 1	Usable parts removed and remainder scrapped	
MOUNTS		
T152E5 Mounts		
Serial Nos. 1 and 2	Akron	
No. 3	Aberdeen Proving Ground	
T152E3 Mounts		
Serial No. 1	Usable parts removed and remainder scrapped	
Nos. 2 & 3	Converted to E4	
No. 4	Usable parts removed and remainder scrapped	
T152E2 Mounts		
Serial Nos. 1 and 2	Usable parts removed and remainder scrapped	
T152E1 Mount		
Serial No. 1	Usable parts removed and remainder scrapped	
T152 Mount		
Serial No. 1	Usable parts removed and remainder scrapped	

The T137 Rifle

Drawings of a redesigned T137 rifle (described in Thirty-First Progress Report) will be released for manufacture during the month of April. The basic design features of the T137E3 rifle have been retained with the following revisions:

(1) The chamber contour has been changed in the attempt to improve gas flow in the chamber.

(2) The breakdown joint has been made selective, so the rifle may be removed from the cradle in one piece if desired.

(3) A gas seal has been incorporated into the breakdown joint.

Preliminary firings at Erie Ordnance Depot show the seal to be effective. Additional tests are planned.

The T152 Mount

A new mount is being made of aluminum. The carriage has the same basic design as the T152E4 mount but two tripods are planned. One tripod made entirely of aluminum has two wheels for man-tow on the ground; the second is the standard T152E4 light weight steel tripod. This mount has a new firing control system which requires much less trigger effort to fire either the major or minor caliber rifle.

The ONTOS Firing System

The design of the firing system for the ONTOS vehicle, outlined in the Thirty-First Progress Report, has been completed. All parts necessary to equip one vehicle for test have been ordered and are scheduled for completion by April 15. When completed the system will be installed on a vehicle at Aberdeen Proving Ground for test.

Future Program

1. Continue test firing to evaluate the gas seal at the breakdown joint.

2. Continue test firing in pressure-station rifle.

3. Prepare new design layouts of rifles and mounts for ultimate BAT system.

4. Redesign the spotting rifle mount to use a T45 spotting rifle.

5. Complete calculations, now in process, to determine the ballistic requirements for the ultimate BAT system objectives.

T138 PROJECTILE

Projectiles for determining the effect of center of gravity location and spin rate on the accuracy of the T138 projectile (Twenty-Ninth Progress Report) have been manufactured. The future program is being amplified to include long range accuracy tests. Adequate range facilities are available at Aberdeen Proving Ground and a request for authorization to carry out these tests at that place is being formulated.

T119 PROJECTILE

Design of Fin-Opening Piston, P-84787C

The Thirtieth Progress Report presented data showing that the fin-opening piston, DRB198, had marginal strength when used without heat treating but was satisfactory after a suitable heat treatment. The piston has been redesigned as shown in Fig. 1. The more generous radii and greater wall thickness of the new design have increased the strength considerably and heat treatment is not required.

These new pistons were tested at Erie Ordnance Depot by firing five projectiles, T119E11, at 115% of service pressure. The pistons were not heat treated. Yaw card measurements of the fin cuts and an inspection of the recovered pistons showed them to be satisfactory. The firing data are presented in Table II.

Cartridge Case Liner Development

The cartridge case liner used at the present time in the T119E11 round consists of an inner viscose rayon sleeve and an outer polyethylene sleeve which are sewed and heat-sealed, respectively, to polyethylene end rings to form a single assembly. A study is being conducted in an effort to improve this liner, DRC479, with respect to ease of manufacture, ease of assembly to the cartridge case, better complete round sealing, and better resistance to powder abrasion. Combining the rayon and polyethylene into a single laminated sheet appeared a promising means of accomplishing these objectives. It was learned that Picatinny Arsenal had a laminated liner consisting of a sheet of viscose rayon, sandwiched between sheets of polyethylene, under development. A liner incorporating such a laminate has been prepared for the T119E11 cartridge and is shown in Fig. 2.

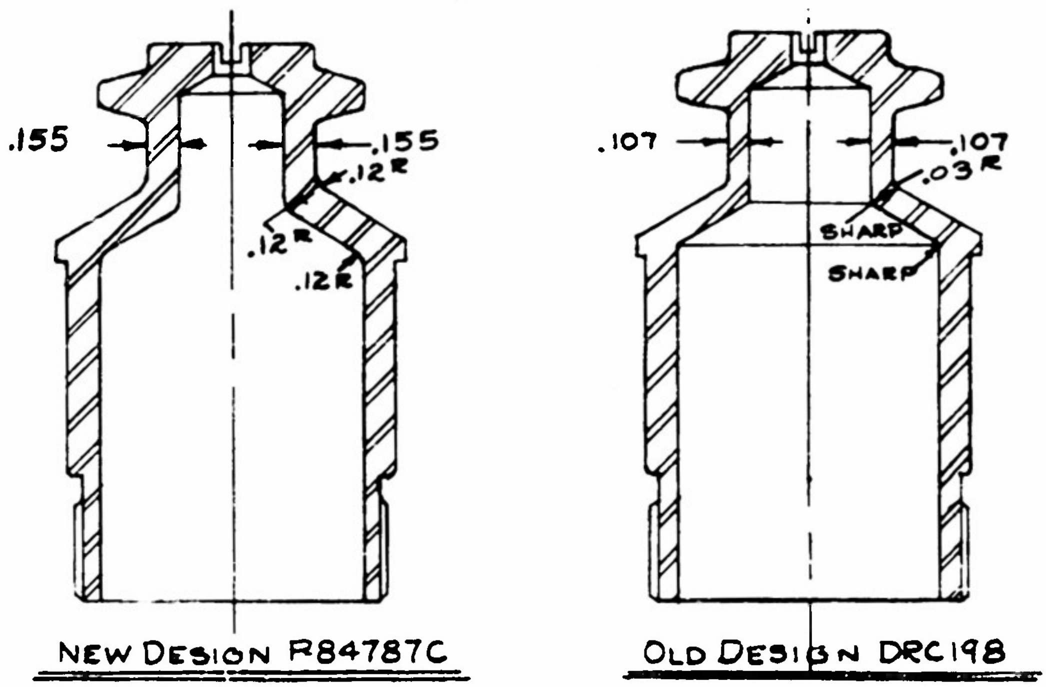

Fig. 1. Cross Sections of Fin-Opening Pistons.
For T119 Projectile.

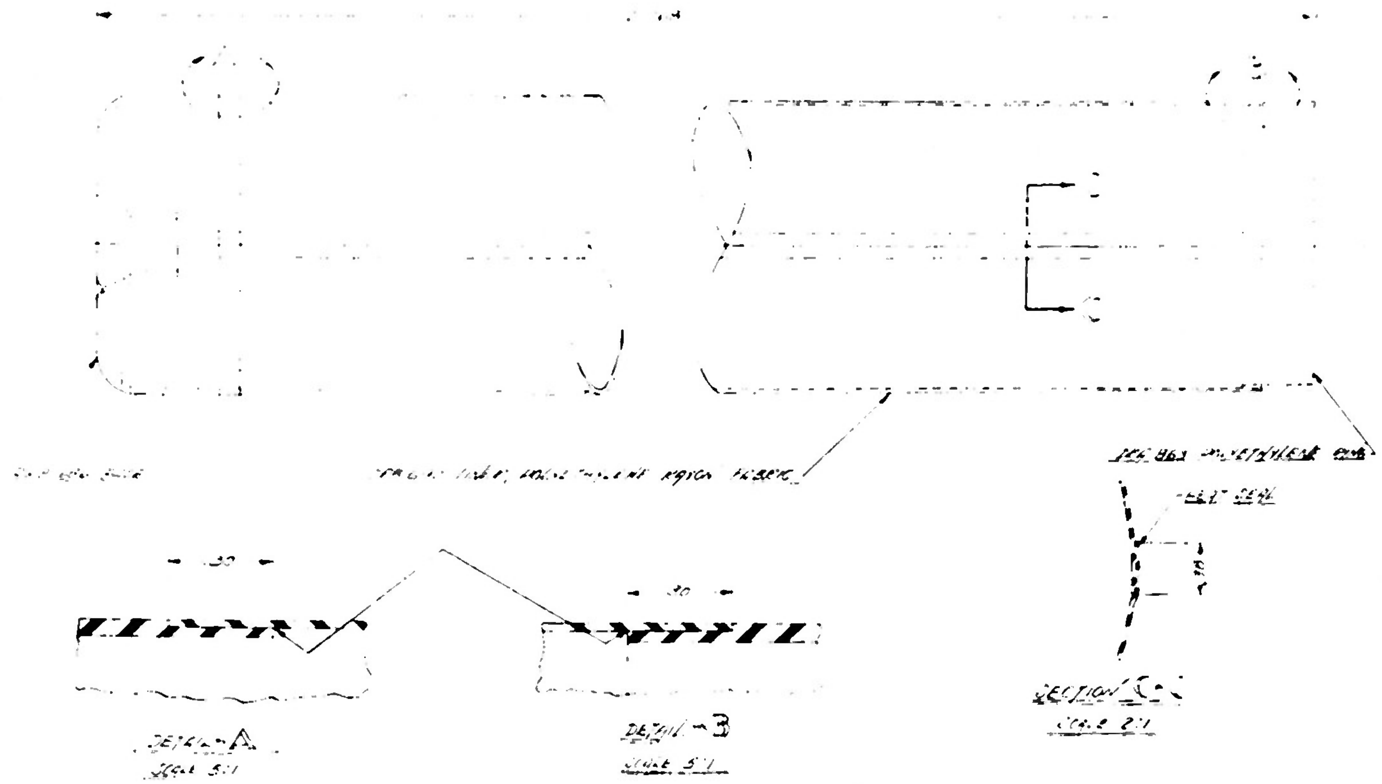

Fig. 2. Laminated Case Liner for T119E11 Cartridge.
Firestone Drawing No. DRC545.

Two samples of laminated polyethylene rayon, 4.60 and 4.73 ozs/sq yd, were obtained for preliminary testing. The sheets were heat-sealed to form simple tapered sleeves which conformed to the inside of the T53E1 cartridge case. The liners were tested to determine their effect on gun ballistics and to determine whether burning of the liner was complete. The present liner, DRC479, was used as a control. The tests were fired in conjunction with fuze tests and the range data are given in Table III. The internal ballistic data are summarized in Table IV.

The different case liners did not cause any appreciable difference in either muzzle velocity or peak pressure but there were slight differences in recoil.

The laminated sheets did not burn as completely as the DRC479 liners, but the few fragments which remained in the gun did not interfere with loading. A laminate with lighter rayon, 3 ozs/sq yd, is being made for additional tests.

Samples of the new laminated liners (DRC545), as shown in Fig. 2, are being manufactured and should be available for tests during April 1953.

Accuracy of T119 Projectiles With Short Fins

To evaluate the effect of fin length on projectile performance, a group of standard T119E11 projectiles were modified by cutting 2 inches off the trailing tips of the fins. The standard fin is 8.92 inches long. The short-finned projectiles were fired alternately with T119E11 projectiles at a target placed at 1049 yards. The range data are given in Table V.

The accuracy of the short-finned projectiles compared favorably with that of the T119E11 projectiles. For twelve T119E11 projectiles, the probable error of the dispersion was .35 mil vertical and .81 mil horizontal. For nine short-finned rounds, the probable error of the dispersion was .67 mil vertical and .45 mil horizontal. One short-finned round has a very low velocity and when the vertical impact point for this round is corrected to the mean velocity of the other eight rounds, the probable error of the vertical dispersion is reduced to .33 mil.

These results with the short-finned round are very encouraging and projectiles with still shorter fins are being prepared for tests.

Projectile Shipments

T119 projectiles manufactured by Firestone and shipped to other installations for purposes not controlled directly by Firestone Defense Research personnel and where custody is transferred are listed in the final section of this report - Manufacturing Summary.

Future Program

1. The study of the effect of fin length on T119 projectile accuracy will be continued. A group of projectiles with fins shortened four inches has been ordered.

2. The manufacture of projectiles with long and short ogives is continuing. These projectiles will be used to determine the effect of ogive length on flight characteristics.

3. Twenty multipiece cases, M32, have been obtained and some of these have been heat-treated. These cases will be tested for strength to determine if they are suitable for BAT ammunition.

4. Projectiles with fewer than six fins will be tested. Components for four-finned and five-finned projectiles are being manufactured.

Table II
Firing Test Data
Strength Test On Fin-Opening Piston
T119 Projectile, P-84787C Piston

Date 3-9-53 Program SUPP T-119 C2

Muzzle — 6117' — 9233' — 2479' — Recovery Box
SCREEN DISTANCES

PROJECTILE
Model T-119
Type E11 Blunt Nose
Weight (Nominal) 17.56
C.G. Location —
Bourrelet Dia (Nom.) 4.132 -.002
Special Features Piston P84787 C

Temperatures
Mag Temps
Max 75°F
Min. 75°F
Pres. 75°F
Loading Room 75°F
Ambient 39°F

Retardation Factor .4 ft/sec/ft

TEST GUN
Model T137E3 No 1
Type 105 mm Recoilless
Length of Tube 105"
Twist of Rifling 1-20
Sighting Equipment M-17 Adapted Telescope
Bore Dia. (Lands) 4.139 +.001
Tube 22B-849-C
Chamber 22B-775-B
Vent Ring 22B-81-X A
Pendulum Mount

MISCELLANEOUS DATA
Range Recovery Box
Propellant PA30246 M-57 Primer
Type M10 web .0335in Charge Wt 8 lbs, 5 oz.
Proof Director E. Huffman
Observers N. Mercer
T53 F1 Cases - Rayon & Polyethelene Liners

Round No	Proj. No.	Proj. Weight (lbs.)	Powder Charge (lb. - oz.)	Recoil	Chamber Pressure (psi)	Muzzle Velocity Instr	Muzzle Velocity Actual	Elev. (mils)	Fired	Condition of Piston after Firing	Fin Spread (in.) 1st Yaw Card	Fin Spread (in.) 2nd Yaw Card	Fin Spread (in.) 3rd Yaw Card	Observations
4590 1	X 332	17.59	8 - 5	1⅝ R	12,300 / 12,800	1718	1761		Solenoid Mechanical	No Deformation	10⅝ x 10½ x 10⅝	10⅝ x 10⅝ x 10½	10⅝ x 10⅝ x 10¾	Slight Yaw
4591 2	X 333	17.59	8 - 5	3⅝ R	11,900 / 11,700	1665	1700		Lanyard	No Deformation	10⅝ x 10⅝ x 10½	10⅝ x 10⅝ x 10⅝	10⅝ x 10⅝ x 10½	Slight Yaw Slight Bulge in case
4592 3	X 334	17.56	8 - 5	3⅞ R	12,100 / 13,300	1715	1758		Solenoid	No Deformation	10⅞ x 11 x 11	10⅝ x 10⅝ x 10⅝	11 x 11 x 10⅞	Slight Yaw
4593 4	X 335	17.56	8 - 5	1 R	12,000 / 12,400	1702	1745		Solenoid	No Deformation	10¾ x 10⅞ x 10⅝	10⅝ x 10⅝ x 10⅝	10⅝ x 10⅝ x 10¾	
4594 5	X 331	17.56	8 - 5	4⅞ R	12,200 / 12,500	1708	1751		Lanyard	No Deformation	10⅝ x 10⅝ x 10⅝	10⅝ x 10⅞ x 10½	10⅝ x 10⅝ x 10¾	

Notes: Fastax pictures were taken of first round.
Yaw cards were placed on the first and second screens and on the front of the recovery box.
Allowable fin spread variation: 10.55 to 10.82 inches.
e Internal M-3 (cu)

Signed O. Miller

Table III
Firing Test Data
To Test Laminated Case Liner, DRC545

[Gun] 67.08' | 92.25' | 145 Yds. | 4' Wooden Bursting Screen

1st Coil — 2nd Coil

PROJECTILE
Model T-138
Type E-3 I A
Weight (Nominal) 17.30
C.G. Location
Bourrelet Dia (Nom.) 4.132 -.002
Special Features Band 360-6

TEMPERATURES
Mag Temps.
Max. 70° F.
min. 70° F.
Pres. 70° F.
Loading Room 70°F
Ambient 67°F.
Late Afternoon

Date March 25, 1953 Program Supp. II

TEST GUN
Model T-137 E9 #2
Type 105mm Recoilless
Length of Tube 105"
Twist of Rifling 1-200
Sighting Equipment M-17 Adapted Telescope
Bore Dia. (Lands) 4.134 +.001

Tube 228-775-B
Chamber 228-353
V. Hing 228-350-DA
Pendulum Mount

Pendulum Constant = 2.00 lbs.-sec/in.
Lanyard fired mechanical

MISCELLANEOUS DATA
Range 200 yds.
Propellant OAC 290 Primer T-36E6 MOD
Type M10MP web .0365 Charge Wt. 8 lbs 2oz. T53 E1 Cases
Proof Director J. Cheney
Observers Dr. Lucas W. Russell R. Burns R. McLean

Round No		Liner Type	Proj. Weight (lbs.)	Fuze No.	Recoil	Chamber Pressure # (psi)	Muzzle Velocity Instr.	Muzzle Velocity Actual	Powder Depth	Piezo Pressure Gage No. 105	Chamber Inspection After Firing	Fuze Type			Observations
4615	1	T-113 Hard DRC 479	17.34	6	3¾" R	10,300 / 9,600	1598	1626	4⅝"	—	A few slivers of propellant in chamber. Bore Clean	T-267E13	Delay		Functioned
4616	2	↓	17.29	3	14½" R	8,700 / [illegible]	1600	1628	4"	—	Chamber and Bore clean.	T-267E13	Super	Quick	Functioned
4617	3		17.39	4	5⅛" R	8,600 / [illegible]	1569	1597	4"	11,100	" " "	T-267E13	Delay		Functioned
4618	4		17.29	1	13¾" R	9,100 / [illegible]	1576	1604	3⅝"	—	" " "	T-267E13			Failed to Function
4619	5		17.30	5	3½" R	[illegible] / 10,200	1605	1633	3⅝"	—	" " "	T-267E13			Failed to Function
4620	6		17.34	7	7⅝" R	10,000 / [illegible]	1608	1636	3⅝"	—	" " "	T-267E13	Delay		Functioned
4621	7	↓	17.30	2	13¾" R	9,600 / 9,500	1603	1631	4⅝	12,050	" " "	T-267E13	Delay		Functioned
4622	8	Laminated Type A	17.19	26	13" R	10,000 / 9,700	1609	1652	4"	5,800	Two scraps of rayon ½" x 2" in case. Bore Clean	T-223			Failed to Function
4623	9	" A	17.19	21	6" R	9,700 / 9,500	1576	1604	4⅝"	—	Two scraps of rayon ½ x 1 in case. Chamber & Bore Clean.	T-223	Delay		Functioned
4624	10	" B	17.20	23	7⅝" R	9,400 / 9,700	1572	1600	3⅝	11,250	Chamber and Bore Clean	T-223	Delay		Functioned
4625	11	" B	17.22	25	11" R	9,900 / 9,800	1600	1628	3⅝	—	3 ½ x ½ Scrap in chamber Bore Clean.	T-223			Not Observed
4626	12	" A	17.15	28	6½" R	9,410 / 9,600	1578	1606	4⅝"	9,000	½ x ½ Scrap in Case. 4 small scraps in bore ½ x ½.	T-223			missed Screen
4627	13	" A	16.91	22	12⅝" R	9,600 / 9,800	1629	1657	4⅝"	9,700	3 scraps ½ x 2 in case. ½ x ½ scrap in bore	T-223	Delay		Functioned
4628	14	" A	16.89	24	10⅝" R	10,500 / 10,100	1621	1649	4½"	10,000	A small scrap in chamber. Bore Clean.	T-223			Failed to Function
4629	15	" B	17.16	29	6" R	9,300 / 9,400	1589	1615	4⅝	9,950	3 scraps in case. ½ x 1" Two small scraps in chamber	T-223			Failed to Function
4630	16	" B	17.17	27	13⅝" R	9,600 / 9,000	1608	1636	4½"	9,700	A very small scrap in tube. Chamber & Case clean.	T-223	Delay		Functioned
4631	17	B	17.20	30	8⅝" R	— / —	1596	1624	4½"	9,000	A 3" x ½" Scrap in Case. 4 very small scraps in tube.	T-223	Delay		Functioned

\# Internal M-3 (Cu)

Notes: All rounds were loaded and fired (with one white rubber pad) as single units. Powder Depth taken after w/ Rubber pad inserted.
Round #11 fired pre-maturely as chamber was closed (No explanation)
Piezo Gage No 105 (Con. = 508/01 μ coulomb) (Cap: 472 μ farads).
Liners: DRC 479 (polyethylene & Rayon in separate sleeves)
Laminate Type A 4.73 oz. per sq. yd. rayon between sheets of 2 mil polyethylene.
Laminate Type B 4.60 oz. " " " " " " " "

Signed O. Miller

Table IV
Internal Ballistic Data
Cartridge Case Liner Tests

Round No.	Liner	Recoil (in.)	Internal M3 Pressure	Muzzle Velocity (ft/sec)
1	T119 DRC479	3 3/4R	9,900	1626
2	"	14 1/2 R	8,750	1628
3	"	5 1/4 R	9,700	1597
4	"	13 3/4 R	9,000	1604
5	"	3 1/2 R	10,000	1633
6	"	7 1/4 R	9,500	1636
7	"	13 3/4 R	9,550	1631
Average		8.82 R	9,500	1622
8	Type A	13 R	9,850	1632
9	"	6 R	9,600	1604
12	"	6 1/2 R	8,950	1606
13	"	12 1/4 R	9,700	1657
14	"	10 1/4 R	10,050	1649
Average		9.6 R	9,600	1630
10	Type B	7 1/4 R	9,550	1600
11	"	11 R	9,700	1628
15	"	6 R	9,500	1615
16	"	13 1/4 R	9,250	1636
17	"	8 1/4 R	--	1624
Average		9.15 R	9,500	1621

Notes:

Liner DRC479 - separate sleeves - polyethylene .005 in. thick and rayon, 5.00 to 5.75 ozs/sq yd, Spec. PA-PD-29.

Liner Type A - laminate of rayon, 4.73 ozs/sq yd, between polyethylene sheets, .002 in.thick.

Liner Type B - laminate of rayon, 4.60 ozs/ sq yd, between polyethylene sheets, .002 in.thick.

Table V
Range Data
Accuracy of T119 Projectiles With Short Fins

RANGE DATA

Date of Test March 25 1953

Purpose of Test Effect of fin length on accuracy of T-119 Projectile
Program Supp. T115 C2

SCREEN DISTANCES: Muzzle — 137.33' — 1st Screen — 45.00' — 2nd Screen

PROJECTILE
Model T 119
Type E11 with standard 8.92 inch fin and E11 with short 6.92 inch fin
Weight 17.52 lbs.
C G Location
Bourrelet Dia 4.132 -.000
Special Features Variable fin length

Bore Dia. 4.134 +.001
Measuring Point 0,0
Aiming Point 0,-72 in from target center.
Solenoid fired - mechanical
1 mil = 37.8 inches @ 1049 yds.

TEST GUN
Model T137E3 #2
Type 105 MM Recoilless
Serial No
Chamber 228-351
Bushing (Vent) 228-350-D-A 228-300-L-A
Tube 228-842-C 105mm - 1/20
Sighting Equipment M69E4 Sight on T-183 Mount; Gunner's Quadrant M1 #78201
Mount
Type T-152E5
Serial

MISCELLANEOUS DATA
Range 1049 yd. Line of fire 38° (Clockwise from Magnetic North)
Propellant
Type MP-M9 Web .0265 Weight 8 lb - 4 oz.
Lot No RAD 27A.
Primer M-57
Shell Case T-53E1
Liner DRC 479
Temperatures
Magazine
Max 70° Min 70° Present 70°
Loading Room 72° Ambient 44°

Round No	Time of Flight	Proj Weight (lb.)	Proj Number	Wind Vel	Wind Dir *	Normal Wind Component	Muzzle Velocity ft/sec Instr	Muzzle Velocity ft/sec Actual	Super Elev. (mils)	Azimuth inches from Center	Position of Hit (inches) Vert	Position of Hit (inches) Horiz	Corrected Position of Hit — mils Vert	Corrected Position of Hit — mils Horiz	Chamber Pressure Copper	Chamber Pressure Piezo	Fin Diameter	Observations
Warm up																		
4635 1			X287	10	270	7.9	1665	1596	25	-72	39 D	23½ R	-1.03 D	+0.62 R		10,450	10⅝, 10⅝, 10⅝	
4636 2			X289	13	280	11.5	1570	1608	25	-72					8,800	9951		Fell short and about 2 mils right of center; Loose sight
4637 3			X300	14	280	12.4	1580	1617	26	-72	38 U	12 L	+1.01 U	-0.32 L	8,700	10,299		
4638 4			X309	10	265	9.2	1591	1632	26	-72					9,100	10,618		Appeared to pass between top of target and top of target frame.
4639 5		17.50	X310 0	19	275	11.7	1590	1631	25	-72	34 U	38 R	+0.90 U	+1.01 R	8,700	10,291		
4640 6			X091	9	285	8.3	1537	1624	25	-72	7½ U	34 L	+0.20 U	-0.90 L	8,800	10,212		
4641 7		17.52	X3263	7	270	5.5	1594	1625	25	-72	54½ U	16½ L	+1.44 U	-0.44 L	8,800	10,155		
4642 8			X294	16	280	8.8	1592	1624	25	-72	13 D	100 L	-0.34 D	-2.65 L	8,000	10,488	10⅝, 10⅝, [illegible]	Yaw-hole diameter 4⅝" x5
4643 9		17.50	X3219	9	300	8.3	1592	1623	25	-72	46½ U	4 L	+1.23 U	-0.11 L	9,000	9951		
4644 10			X298	8	260	5.4	1587	1618	25	-72	42 U	36 R	+1.11 U	+0.95 R	8,500	9,618		
4645 11		17.50	X3200	7	246	2.8	1588	1619	25	-72	39 U	34 L	+1.03 U	-0.90 L		9,759		
4646 12			X297	7	250	3.7	1605	1636	25	-72	50½ U	63 L	+1.34 U	-1.67 L		10,579		
4647 13		17.50	X3175	12	230	3.5	1547	1578	25	-72	55 D	32 L	-1.46 D	-0.85 L		10,182	8⅝, 8⅝	Omitted from PE - Low velocity
4648 14			X292	17	260	11.4	1577	1608	25	-72	22 U	32.1 L	+0.58 U	-0.88 L		10,523		
4649 15		17.50	X3273	14	280	12.4	1533	1630	25	-72	52 U	6 R	+1.38 U	+0.17 R				
4650 16			X092	7	270	5.5	1591	1622	25	-72	44½ U	12 R	+1.18 U	+0.32 R		10,463		
4651 17			X225	11	270	8.7	1599	1630	25	-72	16½ U	20 L	+0.44 U	-0.53 L		10,771		
4652 18		17.50	X3305	11	295	10.7	1588	1619	25	-72	39 U	10½ R	+1.03 U	+0.28 R		11,008		
4653 19			X296	12	285	11.0	1575	1666	25	-72	0	78 L	0.00	-2.06 L				
4654 20		17.50	X3296	22	280	19.4	1575	1600	25	-72	2 U	31½ R	+0.05 U	+0.83 R				
4655 21			X289	19	285	17.5	1591	1622	25	-72	5 D	46½ R	-0.13 D	+1.23 R			10⅝, 10⅝, 10⅝	
4656 22		17.50	X3183	16	280	14.1	1582	1614	25	-72	43½ U	2½ R	+1.15 U	+0.07 R				

* Clockwise from Magnetic North

CONTINUED ON NEXT PAGE

Table V (Cont.)

RANGE DATA

Date of Test March 27, 1953

Purpose of Test Effect of fin length on accuracy of T-119 Projectile
Program Supp. T119-2

PROJECTILE

Model T119
Type E11 with standard 8.92 inch fin and E11 with short 6.92 inch fin.
Weight 17.52 lbs.
C.G. Location
Bourrelet Dia 4.122 $^{-.002}$
Special Features Variable fin length.

Bore Dia. 4.139 $^{+.001}$
Measuring Point 0.0
Aiming Point 0,-72 in from target center.
Solenoid fired-mechanical
1 mil = 328 inches @ 1049 yds.

TEST GUN

Model T137E3 #2
Type 105 mm Recoilless
Serial No
Chamber 228 383
Bushing (Vent) 28B459 DA 228-388-AA.
Tube #228-849C. 105 in - 1/8
Sighting Equipment M62 E4 Sight on T-183 Mount
Gunner Quadrant M1 #78861
Mount
Type T-15255
Serial

MISCELLANEOUS DATA

Range Bay 15B, 1049 yd. Line of fire 38° (Clockwise from magnetic north)
Propellant
Type MP-M10 Web .0365 Weight 2 lbs. 4 oz.
Lot No RAD 27A
Primer M57
Shell Case T53E1
Liner DRC 479
Temperatures
Magazine
Max 70° Min 70° Present 70°
Loading Room 73° Ambient 44°

Round No	Time of Flight	Proj. Weight (lb.)	Proj. Number	Wind Vel.	Wind Dir.*	Normal Wind Component	Muzzle Velocity ft/sec Instr.	Muzzle Velocity ft/sec Actual	Super Elev. (Mils)	Azimuth inches from Center	Position of Hit (inches) Vert	Position of Hit (inches) Horiz.	Corrected Position of Hit – mils Vert	Corrected Position of Hit – mils Horiz.	Recoil (in.)	Observations
4657 23			X282	11	280	9.7	1579	1610	25	-72	3½	2 L	+.025	-0.06 L		
4658 24		12.51	X3249	12	270	9.6	1598	1629	25	-72	Round appeared to enter target, however no hole was found, possibly due to sagging target panels.					
4659 25			X285	17	270	13.4	1577	1608	25	-72	28 U	2½ L	-0.74 U	-0.07 L		
4660 26		17.52	X322S	15	255	9.0	1587	1618	25	-72	Round appeared to enter target, however no hole was found, possibly due to sagging target panel.					
4661 27			X289	8	265	5.9	1586	1617	25	-72	9 U	20 R	+0.24 U	+0.53 R		

Note (a) All rounds were loaded and fired as simple units; No wadding was used.
(b) The letter S refers to short fin projectiles.

Total number rounds thru chamber 313 rounds

Heavy shorting wire for time of flight prevented getting fin diameter measurements on target.

TABLE OF PROBABLE ERRORS

Description	Method	Vert.	Horiz.
12 Long Fin Projectiles	Root mean Square	.35	.81
8 Short Fin Projectiles	" "	.36	.42
12 Long Fin Projectiles	Successive Diff.	.32	.92
8 Short Fin Projectiles	" "	.41	.40
9 Short Fin Projectiles	Root mean Square	.67	.45
9 " " incl. RD4697 which was corrected for velocity.	" " "	.33	.45
21 Long and Short Fin Projectiles	Root mean Square	.52	.69

* Clockwise from magnetic North

Proof Director E. Huffman R. Dwyer
Observers M. Cox Dr. Lucas L. Sweatly D. Miller
Signed R.A. McLean

PENETRATION STUDIES

Scaling Studies

The penetration-standoff behavior of DRB398 copper cones, modified by cutting off the base to a diameter suitable for use in a 90mm projectile, was described in the Twenty-Fifth Progress Report. This program has continued and the penetration-spin rate studies have been completed. The cones and test assemblies, Figs. 3 and 4, employed in this program are identical with those used in the standoff study. The penetration data are shown in Table VI and in Fig. 5. The behavior of the unmodified 105mm cone and charge is also shown in Fig. 5 for comparison. There is nothing unusual in these data; the loss in penetration caused by rotation is about that to be expected.

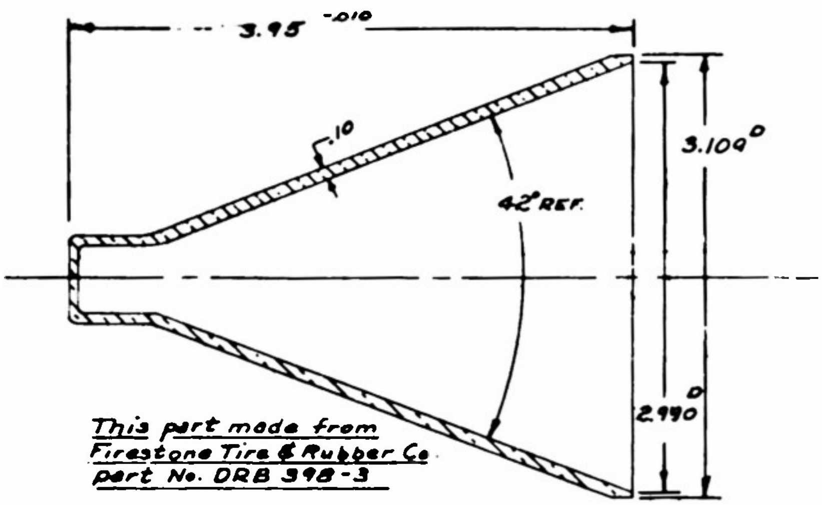

Fig. 3. Modified DRB398 Cone.

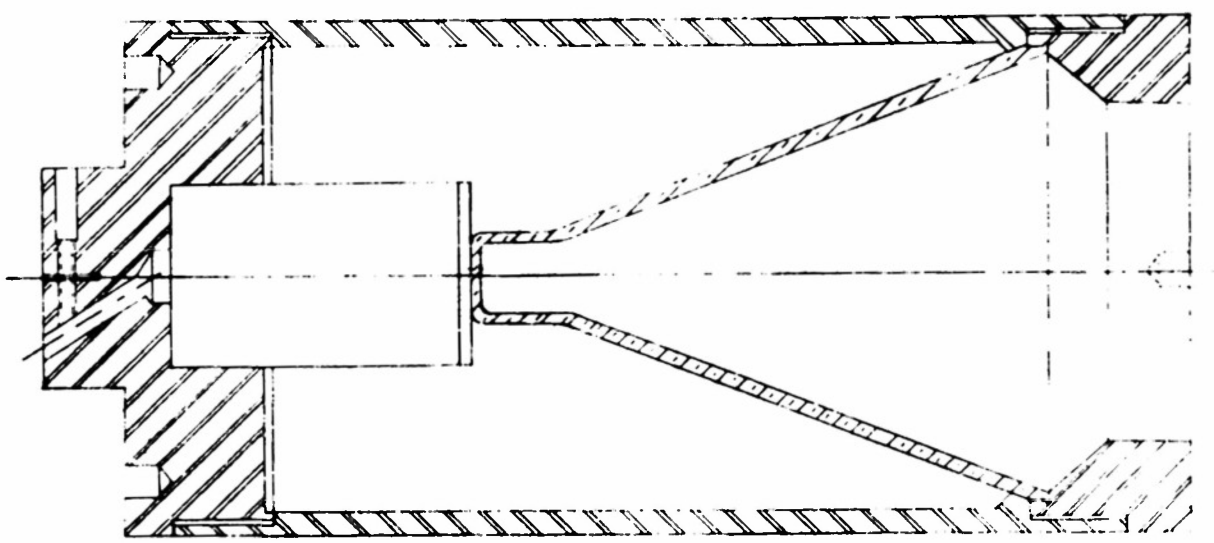

Fig. 4. Test Assembly for 90 mm. Tests.

Table VI
Penetration Data
90 mm. Test Projectiles

Round No.	Concentricity Cone Tip T.I.R.	Lbs. Comp. B	Standoff (in.)	Rate (rev./sec)	Penetration (inches M.S.)	Max. Spread (in.)	Std. Dev. (in.)
MR I 18	.007	1.76	6.5	0	16.94		
MR I 19	.004	1.78	6.50	0	16.18		
MR I 20	.017	1.76	6.50	0	16.06		
					Avg. 16.39	0.88	±.48
MR I 21	.025	1.80	6.50	15	14.75		
MR I 22	.019	1.76	6.50	15	15.94		
MR I 23	.018	1.76	6.50	15	low order		
					Avg. 15.35	1.19	--
MR I 15	.014	1.74	6.50	30	11.31		
MR I 16	.007	1.76	6.50	30	11.75		
MR I 17	.012	1.78	6.50	30	11.38		
					Avg. 11.48	0.44	±.24
MR I 12	.013	1.78	6.50	45	7.18		
MR I 13	.010	1.78	6.50	45	8.25		
MR I 14	.025	1.76	6.50	45	9.62		
					Avg. 8.35	2.44	±1.22

Notes:
1. DRB398 drawn copper cones modified to 3.109 inches base diameter.
2. Penetration Test Base Elements were used. See Fig. 12, Twenty-Third Progress Report.
3. Loaded at Ravenna Arsenal, BAT Lot No. 26, with Composition B from Holston Lot No. 3-126.
4. Tested at Erie Ordnance Depot.

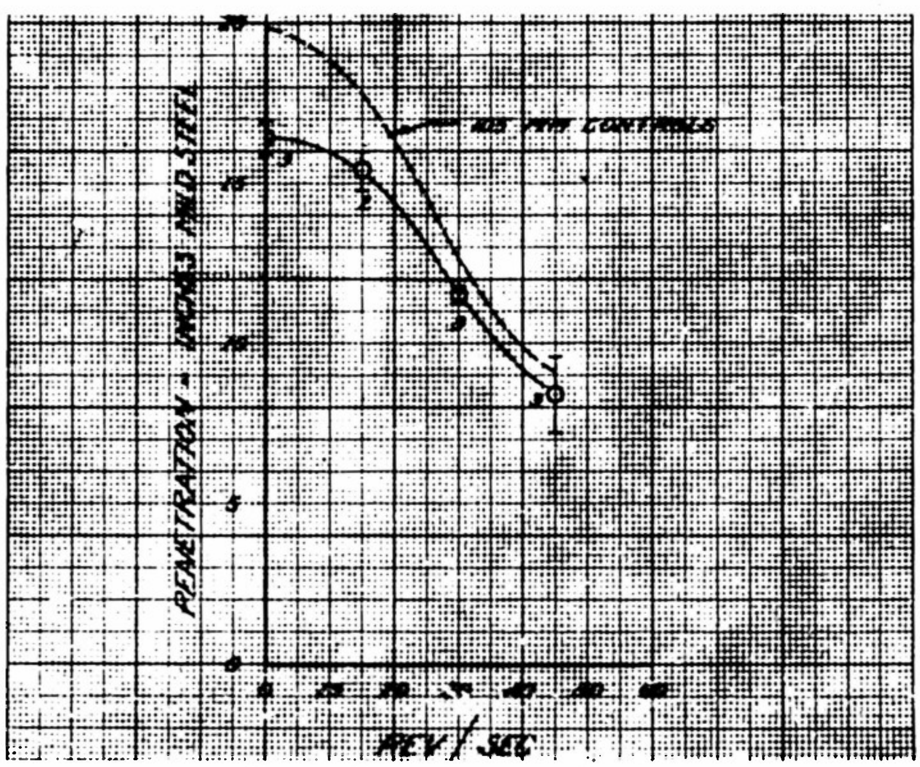

Fig. 5. Penetration Versus Rotation.
MRI 90 mm. Test Projectile; 105 mm Controls.

Effect of Standoff
Drawn, Machined and Recoined Cones

Three types of copper cones, each representing a different type of manufacturing history, have been tested for penetration into mild steel target placed at various standoff distances. The cone types are as follows: (1) drawn from copper strip, (2) drawn from copper strip and recoined between matching steel dies at a total load of 900 tons, and (3) machined from hard drawn copper bar. The "as drawn" copper cones are given three coining operations in the normal course of operation, but these are at a maximum load of about 125 tons. At such loads the walls are straightened but the copper does not flow and the "structure" of the cone is essentially that of the initial plate. The "recoining" operation at high pressure causes a considerable amount of flow of the copper and it is therefore assumed that the structure is considerably different from that of the initially drawn cone. The machined cones have the structure of cold drawn copper bar from which they were made and this is, of course, different from either the drawn or recoined cones. From the point of view of transverse structural symmetry, however, the machined cone should be the most uniform, followed in order by the recoined cones and the drawn cones.

The inspection data are shown in Tables VII to IX, inclusive, and the penetration data in Tables X to XII, inclusive. The penetration-standoff curves for these cones are shown in Fig. 6.

The inspection data show quite clearly that the machined cones are much more precisely made than either the drawn or recoined cones, but they do not disclose any improvement in the dimensional precision of the drawn cones as a result of the recoining operation. However, a visual comparison of the drawn and recoined liners does disclose one difference which may be of importance. The wall waviness in the "as drawn" cones occurs as a series of more or less sharp steps, but in the recoining operation these steps are smoothed out and cannot be detected without instruments.

The penetration data show striking differences in the performance of these three series of cones at long standoff distances, but little difference at short or optimum standoff. The optimum for these cones and test assemblies is 15 inches (4.5 C.D.) and at this distance the penetration for all cones averages 21.5 inches of mild steel (6.5 C.D.). At a standoff of 42 inches (12.7 C.D.) the average penetration of the machined cones is 20.5 inches, the recoined cones, 17.5 inches and the drawn cones, 13.2 inches. As the standoff increases beyond the optimum the penetration data show an increasing scatter - the good penetrations are as high as at the optimum standoff but the number or proportion of bad penetrations increases. It is thought that slight imperfections in the symmetry of the cone geometry and structure cause the jet to waver and that at long standoffs, where the jet has broken into particles, the waver causes a scattering of the jet which in turn results in poorer penetration.

Although there is a striking difference in the performance of the drawn and machined cones it should be emphasized that at standoffs which can be built into conventional projectiles the drawn cones are as satisfactory as machined cones. If, however, some sort of proximity fuze could be developed, or if large spacings can be built into spaced armor, the perfection of the machined cone may become necessary.

Table VII
Inspection Data For DRB398 Liners
"As Drawn" Cones

Cone No.	Wall Thickness - inches			Max.Var.Wall Thick.		Max.Wall Waviness		Concentricity (in.)	
	Max.	Min.	Avg.	Trans.	Long.	I.D.	O.D.	Lower Datum	Upper Datum
Q785	.108	.104	.1062	.0015	.0030	.0025	.0015	.0065	.0070
Q786	.109	.104	.1063	.0010	.0050	.0020	.0015	.0020	.0035
Q787	.109	.105	.1068	.0010	.0040	.0015	.0010	.0020	.0015
Q788	.107	.103	.1049	.0010	.0035	.0020	.0015	.0040	.0025
Q789	.107	.102	.1056	.0010	.0040	.0030	.0015	.0040	.0025
Q790	.109	.105	.1069	.0020	.0020	.0030	.0010	.0025	.0030
Q791	.107	.103	.1059	.0025	.0040	.0040	.0015	.0015	.0020
Q792	.107	.103	.1051	.0020	.0040	.0050	.0020	.0020	.0040
Q793	.107	.104	.1051	.0015	.0030	.0020	.0005	.0040	.0010
Q794	.109	.105	.1070	.0020	.0020	.0020	.0010	.0040	.0030
Q795	.107	.103	.1052	.0020	.0025	.0020	.0005	.0040	.0035
Q796	.107	.104	.1058	.0010	.0025	.0020	.0005	.0030	.0025
Q797	.107	.104	.1052	.0010	.0030	.0020	.0000	.0025	.0080
Q798	.107	.105	.1060	.0020	.0025	.0025	.0005	.0025	.0065
Q799	.108	.104	.1057	.0020	.0040	.0040	.0010	.0020	.0015
Q800	.107	.105	.1061	.0020	.0015	.0020	.0005	.0020	.0055
Q801	.107	.104	.1058	.0025	.0025	.0020	.0010	.0025	.0030
Q802	.108	.106	.1072	.0015	.0020	.0025	.0025	.0035	.0065
Q803	.108	.104	.1063	.0025	.0040	.0030	.0030	.0025	.0015
Q804	.108	.104	.1061	.0020	.0030	.0030	.0015	.0025	.0065
Q805	.108	.105	.1067	.0030	.0020	.0010	.0015	.0040	.0015
Q806	.107	.105	.1060	.0010	.0020	.0030	.0020	.0015	.0010
Q807	.106	.102	.1039	.0015	.0040	.0030	.0020	.0020	.0035
Q808	.109	.102	.1046	.0030	.0060	.0065	.0010	.0080	.0060
Q809	.108	.105	.1069	.0015	.0030	.0020	.0020	.0020	.0085
Q810	.106	.104	.1053	.0020	.0015	.0030	.0010	.0035	.0070
Q811	.107	.103	.1048	.0015	.0040	.0030	.0030	.0020	.0050
Q812	.107	.103	.1052	.0010	.0040	.0040	.0015	.0015	.0030
Q813	.108	.105	.1068	.0025	.0030	.0025	.0015	.0050	.0060
Q814	.108	.103	.1058	.0020	.0040	.0030	.0025	.0030	.0030
Q815	.107	.103	.1051	.0025	.0035	.0035	.0015	.0055	.0070
Q816	.107	.102	.1050	.0030	.0050	.0025	.0020	.0055	.0100
Q817	.108	.105	.1068	.0015	.0030	.0025	.0015	.0025	.0070
Q818	.107	.103	.1051	.0020	.0040	.0040	.0015	.0010	.0035
Q819	.105	.102	.1038	.0020	.0025	.0030	.0010	.0020	.0050
Q820	.106	.104	.1056	.0025	.0020	.0025	.0010	.0055	.0065
Q821	.108	.106	.1071	.0005	.0010	.0020	.0010	.0015	.0035
Q822	.108	.104	.1062	.0015	.0030	.0030	.0020	.0035	.0035
Q823	.109	.103	.1063	.0040	.0030	.0035	.0010	.0030	.0035
Q824	.108	.103	.1050	.0040	.0030	.0035	.0010	.0055	.0055
Q825	.106	.104	.1054	.0020	.0020	.0020	.0020	.0045	.0035
Q826	.108	.104	.1064	.0015	.0035	.0035	.0015	.0045	.0040
Q827	.106	.104	.1049	.0010	.0020	.0040	.0010	.0025	.0065
Q828	.106	.102	.1046	.0040	.0040	.0045	.0020	.0035	.0015
Q829	.108	.105	.1064	.0010	.0030	.0020	.0020	.0040	.0045
Q830	.108	.105	.1064	.0020	.0030	.0030	.0020	.0045	.0050
Q831	.108	.105	.1066	.0020	.0020	.0020	.0015	.0035	.0010
Q832	.108	.102	.1052	.0050	.0030	.0040	.0015	.0015	.0020
Q833	.109	.105	.1074	.0040	.0020	.0030	.0010	.0025	.0045
Q834	.107	.105	.1061	.0020	.0020	.0020	.0010	.0050	.0060
Avg.	.1075	.1039	.1058	.0020	.0030	.0029	.0014	.0033	.0061
Std. Dev.	±.0009	±.0011	±.0008	±.0009	±.0008	±.0014	±.0006	±.0015	±.0029
Specifications:	.105	.100	--	.0020	.0060	.0060	.0060	.0030	.0030

Notes:
1. Variation in straightness or thickness of wall shall not exceed .006 in any axial plane.
2. Variation of wall thickness in any transverse plane shall not exceed .002.
3. The indicated measurement at each datum is the total indicator runout of the liner's outside surface relative to the register diameter. The difference between the runout at the two datum planes is an indication of the lack of perpendicularity of the register plane and the liner axis.
4. Lower datum is .484 inch above the base; upper datum 3.202 inches above base.

Table VIII
Inspection Data For DRB398 Liners
Recoined Cones

Cone No.	Wall Thickness (in.)			Max. Variation W.T.		Max Wall Waviness		Concentricity (T.I.R)		Datum Diam. (O.D.)	
	Max.	Min.	Ave.	Trans.	Long.	I.D.	O.D.	Lower	Upper	Lower	Upper
DRB398 Spec	.105	.100	--	.002	.006	.006	.006	.0030	.0030	3.250 $^{+.010}$	1.164 $^{+.010}$
FS1090	.101	.097	.0993	.001	.003	.003	.002	.0045	.0030	3.218	1.154
FS1091	.102	.098	.1006	.002	.004	.004	.002	.0035	.0060	3.213	1.160
FS1092	.103	.099	.1012	.001	.004	.004	.002	.0025	.0020	3.215	1.165
FS1093	.104	.100	.1019	.002	.004	.003	.002	.0025	.0060	3.217	1.160
FS1094	.101	.099	.1000	.001	.001	.002	.002	.0030	.0030	3.215	1.164
FS1095	.105	.100	.1032	.003	.005	.006	.002	.0030	.0035	3.217	1.160
FS1096	.103	.095	.0995	.002	.008	.003	.002	.0030	.0070	3.216	1.160
FS1097	.105	.100	.1028	.002	.005	.005	.002	.0020	.0020	3.217	1.165
FS1098	.103	.100	.1016	.003	.003	.004	.002	.0030	.0035	3.215	1.161
FS1099	.100	.096	.0984	.003	.002	.002	.002	.0025	.0045	3.216	1.164
FS1100	.102	.099	.1002	.001	.003	.003	.003	.0035	.0030	3.217	1.166
FS1101	.101	.100	.1003	.001	.001	.002	.002	.0020	.0030	3.215	1.157
FS1102	.103	.099	.1009	.002	.004	.005	.002	.0035	.0050	3.216	1.165
FS1103	.102	.100	.1011	.001	.002	.003	.002	.0030	.0040	3.218	1.165
FS1104	.103	.099	.1011	.003	.003	.002	.002	.0020	.0020	3.220	1.160
Avg.	.1025	.0988	.1008	.0019	.0035	.0034	.0021	.0029	.0038	3.2163	1.1617
Std. Dev.	±.0015	±.0016	±.0013	±.0008	±.0019	±.0013	±.0026	±.0007	±.0016	±.0017	±.0035

Notes:

1. Variation in straightness or thickness of wall shall not exceed .006 in any axial plane.
2. Variation of wall thickness in any transverse plane shall not exceed .002.
3. The indicated measurement at each datum is the total indicator runout of the liner's outside surface relative to the register diameter. The difference between the runout at the two datum planes is an indication of the lack of perpendicularity of the register plane and the liner axis.
4. Lower datum is .484 inch above the base; upper datum 3.202 inches above base.

Table IX
Inspection Data For DRB398-6 Liners
Machined Cones

Cone No.	Wall Thickness (in.)			Max. Variation W.T.		Max. Wall Waviness		Concentricity	
	Max.	Min.	Avg.	Trans.	Long.	I.D.	O.D.	Lower Datum	Upper Datum
FS-627	.1040	.1020	.1033	.0010	.0020	.0015	.0005	.0030	.0040
FS-628	.1060	.1035	.1051	.0020	.0025	.0030	.0010	.0050	.0030
FS-629	.1060	.1040	.1051	.0005	.0020	.0030	.0010	.0030	.0030
FS-630	.1060	.1030	.1046	.0005	.0030	.0040	.0015	.0030	.0020
FS-631	.1060	.1010	.1036	.0010	.0050	.0040	.0015	.0025	.0030
FS-632	.1060	.1045	.1052	.0010	.0015	.0020	.0010	.0080	.0100
FS-633	.1055	.1040	.1048	.0010	.0015	.0015	.0015	.0035	.0020
FS-634	.1030	.1025	.1029	.0005	.0005	.0015	.0000	.0030	.0025
FS-635	.1050	.1040	.1046	.0010	.0010	.0015	.0000	.0020	.0010
FS-636	.1020	.1000	.1009	.0005	.0015	.0020	.0000	.0030	.0045
FS-637	.1050	.0995	.1023	.0010	.0050	.0050	.0005	.0040	.0025
FS-638	.1090	.1050	.1068	.0010	.0040	.0050	.0005	.0040	.0045
FS-639	.1050	.1040	.1046	.0010	.0010	.0015	.0000	.0050	.0030
FS-640	.1060	.1040	.1048	.0010	.0020	.0025	.0005	.0030	.0030
FS-641	.1060	.1025	.1042	.0010	.0030	.0035	.0005	.0030	.0045
FS-642	.1065	.1050	.1058	.0010	.0015	.0020	.0005	.0020	.0025
FS-643	.1040	.1020	.1030	.0005	.0020	.0030	.0005	.0045	.0045
FS-644	.1065	.1040	.1055	.0015	.0020	.0010	.0000	.0040	.0020
FS-645	.1040	.1010	.1024	.0005	.0030	.0010	.0005	.0020	.0020
FS-646	.1065	.1040	.1053	.0010	.0015	.0020	.0005	.0030	.0015
FS-647	.1020	.1000	.1014	.0010	.0020	.0015	.0005	.0030	.0030
FS-648	.1080	.1050	.1066	.0005	.0030	.0030	.0010	.0030	.0010
FS-649	.1050	.1030	.1043	.0010	.0020	.0015	.0005	.0025	.0030
FS-650	.1050	.1035	.1043	.0010	.0015	.0010	.0005	.0040	.0045
FS-651	.1065	.1050	.1053	.0015	.0015	.0020	.0000	.0055	.0050
FS-652	.1060	.1040	.1051	.0010	.0020	.0025	.0005	.0020	.0030
FS-653	.1065	.1040	.1054	.0005	.0025	.0020	.0005	.0020	.0015
FS-654	.1050	.1020	.1038	.0010	.0030	.0030	.0000	.0080	.0080
FS-655	.1080	.1070	.1077	.0010	.0010	.0015	.0000	.0015	.0025
FS-656	.1040	.1030	.1033	.0010	.0010	.0015	.0005	.0030	.0015
FS-657	.1050	.1030	.1042	.0010	.0020	.0020	.0000	.0020	.0015
FS-658	.1050	.1040	.1047	.0010	.0010	.0015	.0005	.0025	.0015
FS-659	.0980	.0950	.0966	.0010	.0025	.0030	.0005	.0050	.0050
FS-660	.1055	.1050	.1051	.0005	.0005	.0010	.0000	.0025	.0015
FS-661	.1070	.1055	.1061	.0010	.0010	.0020	.0005	.0045	.0030
FS-662	.1045	.1035	.1041	.0005	.0010	.0010	.0000	.0040	.0010
FS-663	.1060	.1015	.1039	.0005	.0045	.0050	.0005	.0030	.0015
FS-664	.1045	.1020	.1031	.0005	.0025	.0025	.0000	.0035	.0030
FS-665	.1060	.1050	.1057	.0010	.0010	.0010	.0005	.0025	.0020
FS-666	.1040	.1010	.1025	.0010	.0025	.0030	.0005	.0035	.0030
FS-667	.1070	.1040	.1056	.0010	.0020	.0020	.0020	.0030	.0020
FS-668	.1030	.1010	.1021	.0010	.0020	.0020	.0010	.0030	.0030
FS-669	.1055	.1030	.1044	.0010	.0020	.0020	.0010	.0035	.0030
FS-670	.1055	.1040	.1049	.0015	.0015	.0025	.0050	.0040	.0040
FS-671	.1050	.1040	.1046	.0005	.0010	.0010	.0005	.0030	.0020
FS-672	.1060	.1040	.1050	.0000	.0020	.0020	.0000	.0035	.0050
FS-673	.1060	.1030	.1049	.0020	.0030	.0030	.0005	.0020	.0015
FS-674	.1075	.1040	.1057	.0010	.0035	.0040	.0010	.0020	.0020
FS-675	.1050	.1030	.1043	.0010	.0020	.0025	.0000	.0020	.0005
FS-676	.1065	.1050	.1056	.0050	.0015	.0020	.0005	.0020	.0010
FS-891	.1070	.1035	.1050	.0010	.0030	.0020	.0005	.0015	.0010
FS-892	.1080	.1035	.1055	.0010	.0045	.0045	.0005	.0045	.0035
FS-893	.1060	.1020	.1040	.0010	.0035	.0035	.0010	.0020	.0025
FS-894	.1045	.1030	.1039	.0010	.0015	.0020	.0050	.0040	.0040
FS-895	.1040	.1020	.1032	.0010	.0015	.0010	.0000	.0035	.0025
FS-896	.1010	.0975	.0994	.0005	.0035	.0035	.0000	.0035	.0070
FS-897	.1035	.1010	.1026	.0010	.0025	.0040	.0010	.0025	.0015
Avg.	.1053	.1030	.1042	.0010	.0022	.0024	.0007	.0033	.0029
Std. Dev.	±.0018	±.0020	±.0018	±.0006	±.0011	±.001[illegible]	±.0009	±.0013	±.0017
DRB-398-6	.1000	.1050		.0020	.0060	.0060	.0060	.0030	.0030

Notes:
1. Variation in straightness or thickness of wall shall not exceed .006 in any axial plane.
2. Variation of wall thickness in any transverse plane shall not exceed .002.
3. The indicated measurement at each datum is the total indicator runout of the liner's outside surface relative to the register diameter. The difference between the runout at the two datum planes is an indication of the lack of perpendicularity of the register plane and the liner axis.
4. Lower datum is .484 inch above the base; upper datum 3.202 inches above base.

Table X
Penetration Data
"As Drawn" DRB398 Cones

Round No.	Lbs. Comp B	Standoff (in.)	Penetration (inches M.S.)	Max. Spread (inches)	St'd. Dev (inches)
FS851	2.58	4.0	19.31		
FS852	2.58	"	19.38		
FS853	2.60	"	19.18		
FS854	2.58	"	18.25		
FS855	2.60	"	18.19		
			Avg. 18.86	1.19	±0.59
FS856	2.58	7.5	21.00		
FS857	2.58	"	18.94		
FS858	2.60	"	22.18		
FS859	2.58	"	19.38		
FS860	2.58	"	19.38		
Q761	2.60	"	20.75		
Q764	2.58	"	20.25		
Q765	2.60	"	19.62		
Q776	2.60	"	20.38		
Q777	2.60	"	19.12		
			Avg. 20.10	3.24	±1.01
FS861	2.56	15.0	22.25		
FS862	2.56	"	19.31		
FS863	2.58	"	22.06		
FS864	2.56	"	23.18		
FS865	2.60	"	20.31		
			Avg. 21.42	3.87	±1.57
FS866	2.58	22.5	18.06		
FS867	2.58	"	18.25		
FS868	2.58	"	23.75		
FS869	2.58	"	21.62		
FS870	2.60	"	20.44		
			Avg. 20.42	5.69	±2.39
Q584	2.58	31.0	14.44		
Q797	2.62	"	17.31		
Q798	2.60	"	25.06		
Q799	2.62	"	13.25		
Q800	2.64	"	15.12		
			Avg. 17.03	11.81	±4.73
Q801	2.60	37.0	23.38		
Q802	2.62	"	18.50		
Q803	2.64	"	18.31		
Q804	2.62	"	15.00		
Q805	2.62	"	11.25		
			Avg. 17.29	12.13	±4.51
Q806	2.62	42.0	14.94		
Q808	2.58	"	12.06		
Q809	2.62	"	12.18		
Q810	2.60	"	12.69		
Q811	2.62	"	14.25		
			Avg. 13.22	2.88	±1.30

Notes:
1. Cones assembled in DRC376 test assemblies. Boosters were placed in base plugs.
2. Loaded at Ravenna Arsenal, BAT Lot 22 and 27, with Composition B from Holston Lot No. 3-126 and 4-1197.
3. All rounds were tested at Erie Ordnance Depot at 0 rev/sec.

Table XI
Penetration Data
Recoined DRB398 Cones

Round No.	Lbs. Comp B	Standoff (inches)	Penetration (inches M.S.)	Max. Spread (in.)	Std. Dev. (in.)
FS555	2.48	7.5	20.18		
FS557	2.44	"	18.62		
FS558	2.44	"	19.25		
FS559	2.48	"	19.50		
FS560	2.44	"	20.62		
			Avg. 19.63	2.00	±.79
FS1091	2.62	30.0	15.38		
FS1092	2.62	"	23.12		
FS1093	2.60	"	21.00		
FS1094	2.62	"	16.75		
			Avg. 19.06	7.74	±3.62
FS1095	2.58	36.0	22.94		
FS1096	2.60	"	21.31		
FS1097	2.60	"	12.00		
FS1098	2.60	"	24.62		
FS1099	2.60	"	15.75		
			Avg. 19.32	12.62	±5.28
FS1100	2.60	42.0	19.81		
FS1101	2.58	"	21.88		
FS1102	2.60	"	8.62		
FS1103	2.62	"	17.94		
FS1104	2.59	"	19.12		
			Avg. 17.47	13.26	±5.16

Notes:
1. Cones assembled in DRC376 test assemblies. Boosters were placed in base plugs.
2. Loaded at Ravenna Arsenal, BAT Lot No. 12 and 27, with Composition B from Holston Lot 3-126 and 4-1197.
3. All rounds were tested at Erie Ordnance Depot at 0 rev/sec.

Table XII
Penetration Data
Machined DRB398-6 Cones

Round No.	Lbs. Comp B	Standoff (inches)	Penetration (inches M.S.)	Max. Spread (in.)	Std. Dev. (In.)
FS627	2.58	4.0	18.19		
FS628	2.58	"	18.50		
FS629	2.58	"	18.50		
FS630	2.56	"	18.19		
FS631	2.58	"	18.56		
			Avg. 18.39	0.37	±.18
FS632	2.58	7.5	19.94		
FS633	2.58	"	20.56		
FS634	2.60	"	19.56		
FS635	2.58	"	19.12		
FS636	2.58	"	20.50		
			Avg. 19.94	1.44	±.62
FS637	2.58	15.0	21.88		
FS638	2.56	"	20.75		
FS639	2.58	"	20.81		
FS640	2.58	"	22.31		
FS641	2.58	"	21.75		
			Avg. 21.50	1.56	±.69
FS642	2.60	22.5	19.81		
FS643	2.58	"	22.25		
FS644	2.60	"	21.69		
FS645	2.58	"	22.00		
FS646	2.58	"	20.62		
			Avg. 21.27	2.44	±1.03
FS662	2.60	30.0	17.25		
FS663	2.58	"	13.18		
FS664	2.60	"	20.12		
FS665	2.58	"	22.12		
FS666	2.60	"	22.25		
			Avg. 18.98	9.07	±3.83
FS667	2.58	36.0	19.31		
FS668	2.60	"	20.06		
FS669	2.60	"	21.75		
FS670	2.60	"	18.18		
FS671	2.58	"	21.69		
			Avg. 20.20	3.57	±1.57
FS672	2.58	42.0	23.62		
FS673	2.60	"	23.69		
FS674	2.58	"	19.94		
FS675	2.60	"	15.18		
FS676	2.60	"	19.94		
			Avg. 20.47	8.51	±3.50

Notes:
1. Cones assembled in DRC376 test assemblies. Boosters were placed in base plugs.
2. Loaded at Ravenna Arsenal, BAT Lot 23 and 27, with Composition B from Holston Lot No. 3-126 and 4-1197.
3. All rounds were tested at Erie Ordnance Depot at 0 rev/sec.

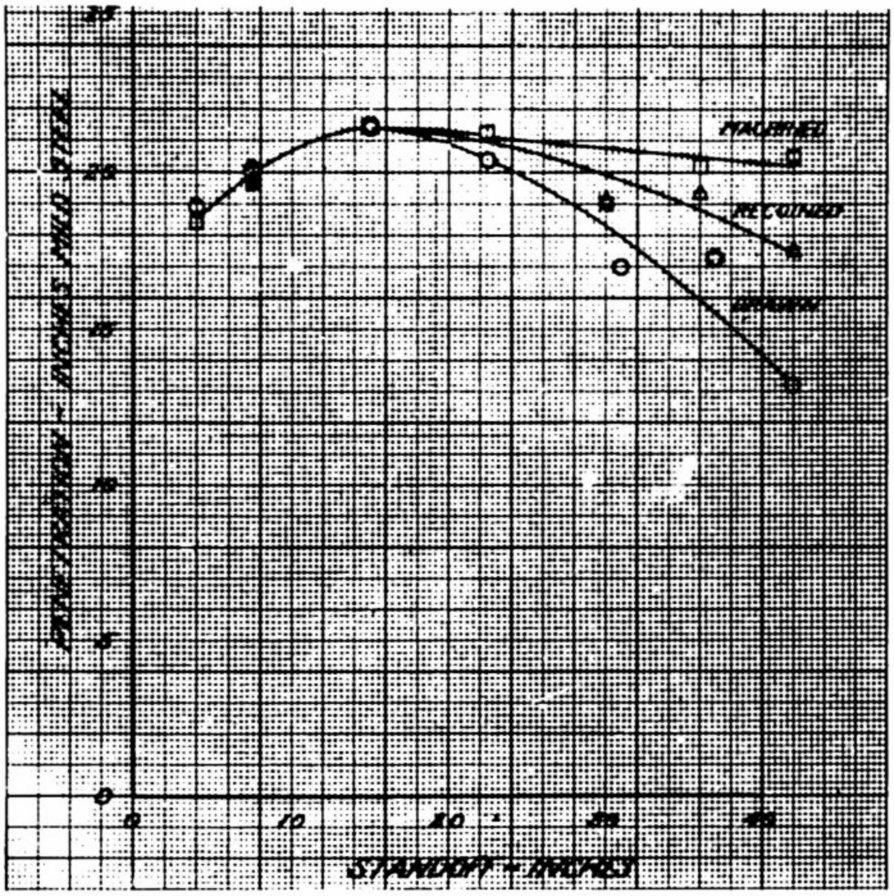

Fig. 6. Penetration Versus Standoff.
Drawn, Recoined and Machined Cones.

Composite Cone Study

The program for evaluating the performance of composite or bimetal cones has been completed. The behavior of copper cones, copper cones with thin aluminum inserts, and of both steel and aluminum cones with thin copper inserts, has been determined at 0 and 30 rev/sec. In each case, the composite cone is composed of an outer shell .080 in thick and a thin insert .020 in thick pressed and rolled into the outer shell. Fig. 7 shows the complete assembly. The copper used was hard drawn oxygen-free electrolytic copper, QQC 576; the steel was SAE 1010 cold drawn bar; the aluminum was 24S-T4 bar. Both shells and inserts were machined. The cones were assembled in modified DRC376 test assemblies, as shown in Fig. 8.

Cone inspection data are shown in Table XIII and the penetration data are shown in Table XIV. Fig. 9 shows the penetration data in a graphical form.

At 30 rev/sec the penetration differential between the types of composite cones is not large, but at 0 rev /sec substantial differences are noted. Early tests with composite cones seemed to show that the penetration achieved by the jet was determined largely by the metal comprising the jet. It was therefore anticipated that the steel and aluminum cones with copper inserts would show penetrations approximating those of the copper cones, and that the copper cones with aluminum inserts would be decidedly inferior. It is surprising, therefore, to note that these latter cones were much the best of the composite cones, and that the copper insert in the steel and aluminum cones did not alter the penetrations from those which would be normally expected for plain steel and aluminum cones without inserts. Fig. 10 illustrates a sectioned target plate and slug for round number FS762, and shows that the copper insert was sufficiently heavy to provide adequate material for the jet. The excellent penetration of the copper cone with aluminum insert is the first obtained in this laboratory in which a jet, presumably composed primarily of aluminum, has demonstrated good penetration. This is of considerable importance in the light of the greater damage beyond the target caused by aluminum jets (NAVORD REPORT "Shaped Charge Damage Beyond Armor" presented as a part of a Symposium on Shaped Charges at Aberdeen Proving Ground, BRL Report 837, page 359). These experiments will be continued in an effort to determine a more optimum composite liner design, and to determine the relative damage beyond the armor.

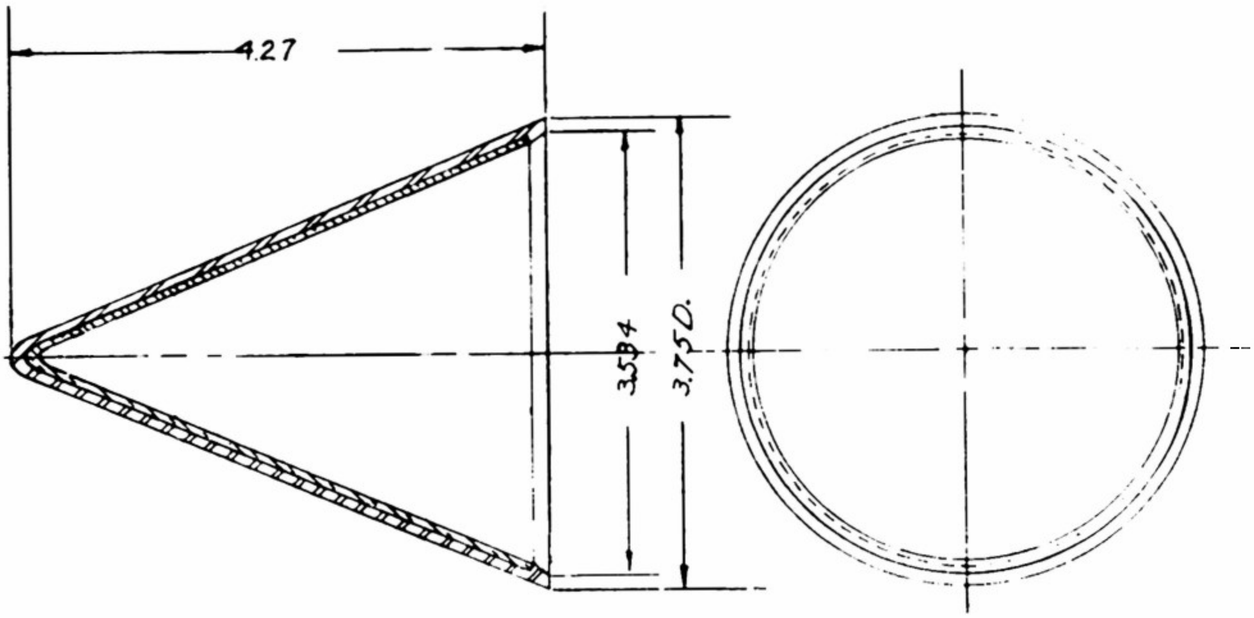

Fig. 7. Composite Cone Assembly.
Firestone Drawing No. DR8660.

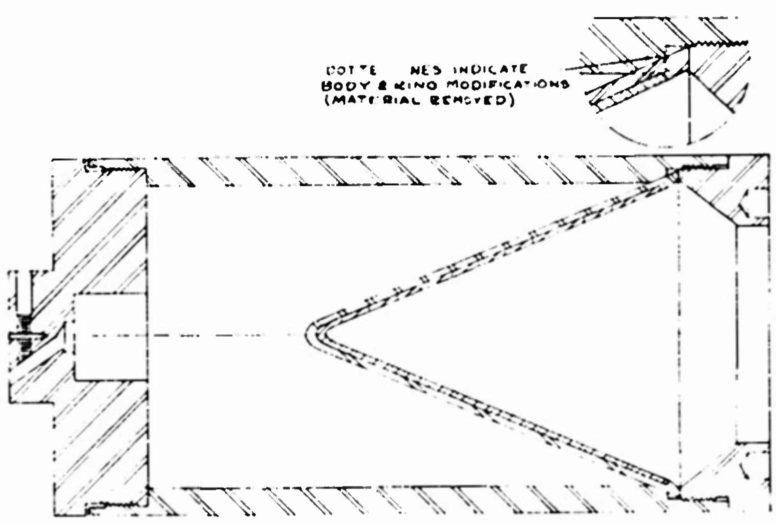

Fig. 8. Modified Test Assembly.
DRC376 Penetration Body Nose and Ring. DR8660 Cone.

Table XIII
Inspection Data
Composite Cones, DRB660

Cone No.	Wall Thickness (in.) Max.	Min.	Ave.	Max. Variation W.T. Trans	Long	Max Wall Waviness I.D.	O.D.	Concentricity* T.I.R. Base Datum*	Apex Datum	Cone Tip in Body Assy
Spec.	.100	.095	--	.001	.003	.003	.003	.0030	.0030	.015 (Nom.)
Solid Copper										
FS750	.099	.097	.0979	.002	.002	.001	<.001	.0030	.0030	.010
FS751	.096	.094	.0946	<.001	.001	.002	<.001	.0035	.0045	.015
FS752	.099	.096	.0973	.002	.003	.001	.001	.0020	.0020	.014
FS753	.100	.096	.0982	.001	.004	.004	.001	.0020	.0025	.007
FS754	.100	.098	.0994	.001	.002	.001	.001	.0005	.0010	.017
FS755	.100	.097	.0988	<.001	.002	.002	<.001	.0010	.0015	.007
FS756	.099	.096	.0972	.001	.003	.003	.001	.0030	.0060	.006
FS757	.101	.098	.1000	.002	.003	.002	<.001	.0010	.0020	.009
FS758	.103	.098	.1006	.002	.004	.003	<.001	.0020	.0025	.013
FS759	.100	.098	.0988	.002	.002	.002	.001	.0045	.0050	.022
Avg.	.0997	.0968	.0983	.0015	.0026	.0021	.0010	.0023	.0030	.0120
Std. Dev.	±.0018	±.0013	±.0017	±.0005	±.0010	±.0010	--	±.0013	±.0017	±.0052
Copper Insert in Steel Shell (20% Cu)										
FS760	.098	.092	.0953	.003	.004	.004	.005	.0045	.0065	.016
FS761	.096	.095	.0953	.001	.001	.001	.002	.0010	.0015	.011
FS762	.102	.097	.1001	.003	.004	.002	.003	.0040	.0045	.009
FS763	.101	.094	.0975	.002	.005	.004	.001	.0030	.0035	.028
FS764	.101	.097	.0992	.001	.003	.002	.001	.0015	.0020	.019
FS765	.106	.101	.1039	.002	.004	.005	.003	.0020	.0025	.004
FS766	.101	.098	.0994	.001	.003	.002	.002	.0025	.0020	.007
FS767	.105	.091	.0986	.003	(.014)	(.011)	.004	.0035	.0035	.020
FS768	.097	.092	.0942	.004	[illegible]	.005	.002	.0010	.0010	.011
FS769	.102	.099	.1006	.001	.003	.003	.002	.0035	.0020	.023
Avg.	.1009	.0956	.0984	.0021	.0030	.0028	.0025	.0027	.0032	.0148
Std. Dev.	±.0032	±.0034	±.0029	±.0011	±.0012	±.0015	±.0013	±.0013	±.0016	±.0077
Aluminum Insert in Copper Shell (20% Aluminum)										
FS770	.105	.099	.1006	.007	.005	.005	.001	.0045	.0025	.030
FS771	.102	.098	.1000	.002	.003	.004	.001	.0020	.0025	.048
FS772	.102	.096	.0994	.002	.004	.004	.001	.0040	.0040	.029
FS773	.101	.098	.0990	.003	.003	.003	.001	.0015	.0010	.013
FS774	.105	.097	.1003	.005	.008	.007	.002	.0060	.0045	.029
FS775	.103	.097	.0999	.001	.006	.004	<.001	.0030	.0030	.013
FS776	.100	.095	.0966	.004	.005	.004	<.001	.0035	.0050	.023
FS777	.099	.093	.0950	.006	.006	.003	.002	.0020	.0040	.014
FS778	.100	.096	.0971	.004	.004	.003	.002	.0015	.0060	.031
FS779	.099	.095	.0970	.002	.003	.003	.002	.0015	.0030	.008
Avg.	.1016	.0964	.0985	.0036	.0047	.0040	.0014	.0030	.0036	.0238
Std. Dev.	±.0023	±.0018	±.0019	±.0020	±.0017	±.0013	±.0005	±.0016	±.0015	±.0119
Copper Insert in Aluminum Shell (20% Cu)										
FS780	.101	.098	.0996	.001	.003	.002	.002	.0010	.0010	.010
FS781	.104	.100	.1018	.004	.003	.004	.003	.0010	.0010	.016
FS782	.102	.099	.1006	<.001	.003	.002	.002	.0025	.0020	.011
FS783	.099	(.092)	(.0951)	.002	.006	.006	.004	.0015	.0010	.014
FS784	.103	.098	.1007	.001	.005	.005	.002	.0010	.0020	.018
FS785	.102	.099	.1004	<.001	.003	.003	.002	.0020	.0020	.004
FS786	.103	.100	.1015	<.001	.003	.003	.004	.0010	.0010	.006
FS787	.103	.099	.1007	.004	.002	.004	.003	.0015	.0030	.005
FS788	.102	.098	.1004	.002	.004	.003	.003	.0015	.0010	.020
FS789	.103	.100	.1006	.003	.003	.002	.004	.0020	.0025	.006
Avg.	.1022	.0990	.1007	.0020	.0035	.0034	.0029	.0015	.0017	.0110
Std. Dev.	±.0012	±.0009	±.0007	±.0013	±.0012	±.0014	±.0009	±.0006	±.0008	±.0058

Notes:
1. Brackets indicated figures are omitted from the averages.
2. The indicated measurement at each datum is the total indicator runout of the liner's outside surface relative to the register diameter. The difference between the runout at the two datum planes is an indication of the lack of perpendicularity of the register plane and the liner axis.
3. Lower datum is .484 inch above the base; upper datum 3.120 inches above the base.

Table XIV
Penetration Data
Composite Cones, DRB660

Round No.	Type Cone	Lbs Comp B	Rev Sec	Penetration (inches M.S.)	Max. Spread (in.)	Std Dev (in.)
FS755	Copper	2.48	0	19.88		
FS756	Copper	2.48	0	19.81		
FS757	Copper	2.48	0	19.25		
FS758	Copper	2.48	0	19.69		
FS759	Copper	2.48	0	20.88		
				Avg. 19.90	1.63	±.53
FS750	Copper	2.50	30	13.75		
FS751	Copper	2.50	30	13.38		
FS752	Copper	2.48	30	14.18		
FS753	Copper	2.48	30	13.56		
FS754	Copper	2.48	30	14.81		
				Avg. 13.94	1.43	±.51
FS765	Cu. Insert/Steel Shell	2.50	0	14.94		
FS766	"	2.48	0	13.38		
FS767	"	2.50	0	13.62		
FS768	"	2.46	0	17.50		
FS769	"	2.50	0	17.56		
				Avg. 15.40	4.18	±1.83
FS760	Cu. Insert/Steel Shell	2.50	30	11.25		
FS761	"	2.50	30	11.06		
FS762	"	2.52	30	11.94		
FS763	"	2.52	30	11.75		
FS764	"	2.52	30	10.94		
				Avg. 11.39	1.00	±.39
FS775	Alum. Insert/Copper Shell	2.50	0	18.12		
FS776	"	2.50	0	16.88		
FS777	"	2.52	0	18.00		
FS778	"	2.50	0	16.38		
FS779	"	2.50	0	18.69		
				Avg. 17.61	2.31	±0.85
FS770	Alum. Insert/Copper Shell	2.52	30	12.06		
FS771	"	2.50	30	8.62		
FS772	"	2.50	30	13.12		
FS773	"	2.50	30	13.18		
FS774	"	2.50	30	10.88		
				Avg. 11.57	3.56	±1.70
FS785	Cu. Insert/Steel Shell	2.50	0	12.38		
FS786	"	2.50	0	11.44		
FS787	"	2.50	0	10.81		
FS788	"	2.52	0	12.38		
FS789	"	2.50	0	8.62		
				Avg. 11.13	3.76	±1.38
FS780	Cu. Insert/Alum. Shell	2.50	30	9.50	No Slugs	
FS781	"	2.50	30	8.94	were observed.	
FS782	"	2.50	30	8.56	Apparently	
FS783	"	2.50	30	9.12	disintegrated.	
FS784	"	2.52	30	9.31		
				Avg. 9.09	0.94	±.32

Notes:
1. DRC576 test bodies, rings, and base plugs.
2. Standoff held constant at 7.5 inches.
3. All cones of the DRB660 type. Simple apex.
4. Loaded at Ravenna Arsenal, BAT Lot No. 26 with Comp B of Holston Lot 3-126.

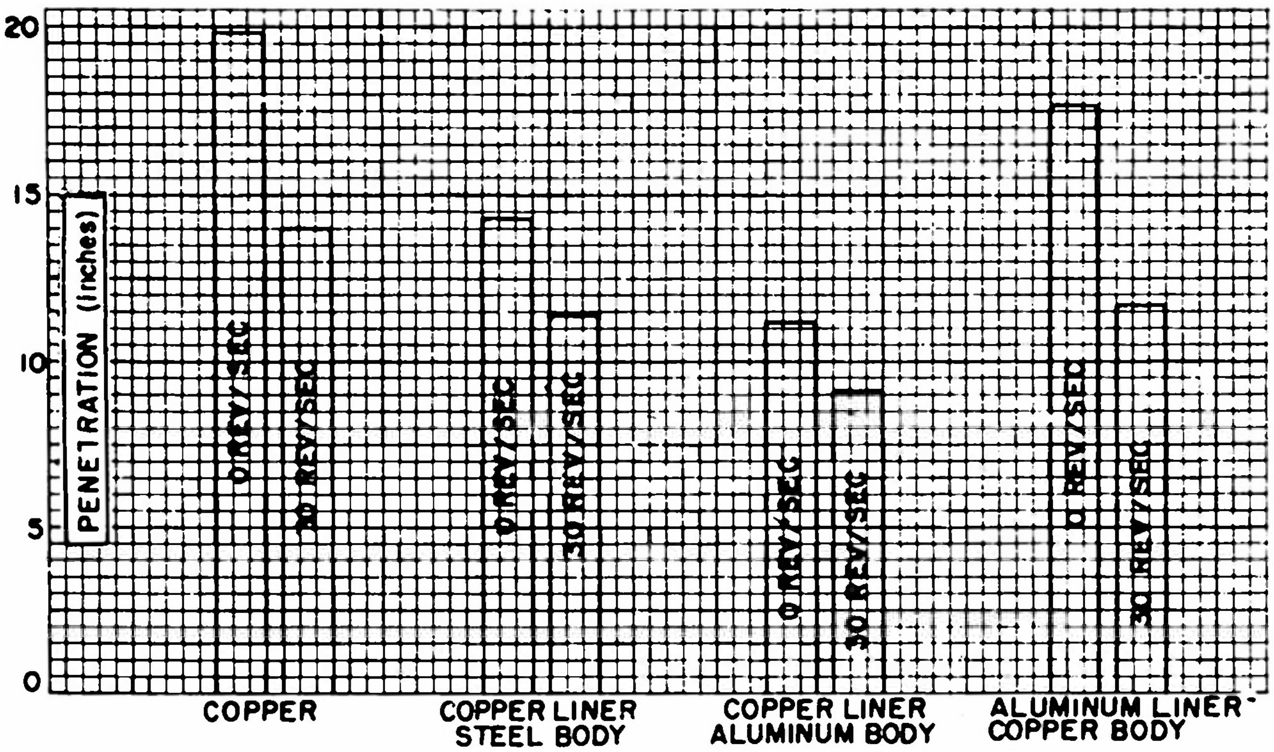

Fig. 9. Penetration Data.
Composite Liners.

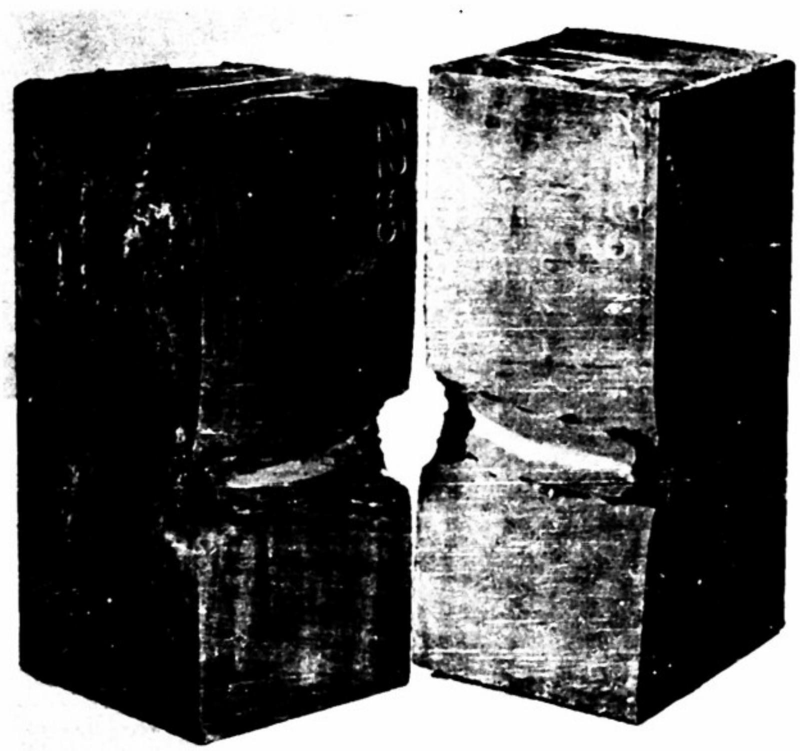

Fig. 10. Section Through Penetration Block.
Showing Copper Core in Steel Slug.

Future Program

1. Effect of Internal Tee Contour. Three new tee designs are to be evaluated.

2. Scaling Studies. Two series of scaling studies are planned. One series with simple apex copper cones is geometrically scaled to 75, 90 and 105mm. The other series uses DRB398 cones (with short spitback of constant size) with height and wall thickness adjusted to 75, 90 and 105mm size.

3. Cones Made of Zinc and Aluminum are to be tested for penetration. Penetrations approaching those of copper cones have been reported for certain aluminum and zinc alloys.

4. Composite Cone Study. A series of tests using copper cones with aluminum inserts will be tested.

a. .080-inch thick copper shell and .020 and .040-inch aluminum insert (24S-T4).

b. .100-inch thick copper shell and .020 and .040-inch aluminum insert (24S-T4).

c. Same as (a) and (b) but using 2S-F aluminum instead of 24S-T4.

FUZES

Testing of T267E13 Base Elements (Superquick and Delay)

A combination superquick and delay fuze, T267, was described in the Thirtieth and Thirty-First Progress Reports. Certain modifications, designed to improve the ease of initiation of the M21 detonator, have been made and tested. The modifications are shown in Fig. 11.

1. *Drop Test on Functioning of Delay Train*

Six T267 fuzes were drop-tested to study the functioning of the delay train. They were loaded with M2 delay detonators, tetryl leads and M21 detonators. Four assemblies T267E13, had .187-inch diameter holes in the M2 detonator sleeves for the escape of gases, while the remaining two fuzes, T267E11 with tetryl leads, had escape holes .0625 in. in diameter. The .187-inch diameter is larger than used in previous tests.

The four fuzes (T267E13) with the .187-inch diameter holes functioned the M21 detonator while the two assemblies with the .0625-inch diameter hole failed to function the detonator even though they did have the special tetryl lead. These results indicate that the failure of other assemblies (T267E11) to function the M21 detonator (reported in the Thirty-First Progress Report) was due to the small size (.0625 in.) of the gas escape hole in the sleeve.

2. *Field Test of T267E13 Fuzes*

Seven projectiles equipped with T267E13 fuzes and spotting charges were fired against a 4-inch bursting screen at a range of 200 yards. All fuzes were set so that both the superquick and delay elements would be activated. Therefore, in the observations a superquick function would obscure a delay function. Observers reported that one fuze functioned superquick at the screen and four functioned as delay fuzes. There was some disagreement among observers as to the functioning of a sixth. One fuze did not function. This fuze had been very erratic in earlier centrifuge tests. Omitting the disputed round, five of six fuzes functioned. The failure of the rounds to function superquick is attributed to inadequate travel in the rotor contact. This condition is being corrected.

Table XV is a copy of the firing record.

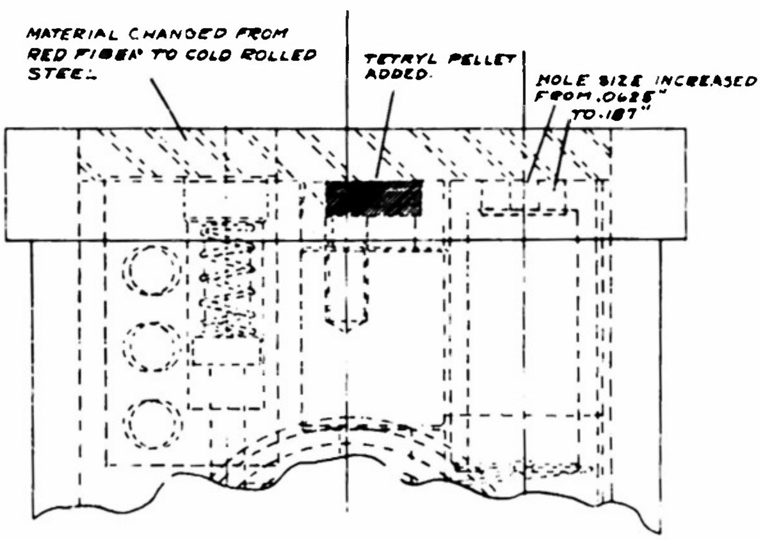

Fig. 11. Modifications to T267 Fuze Base Element.

T223E2 Mechanical Superquick and Delay Fuze

Ten T223E2 fuzes, Twenty-Sixth and Twenty-Eighth Progress Reports, were set to function as delay fuzes and were fired against a 4-inch wooden bursting screen at a range of 200 yards. Five of the ten fuzes were observed to function. One of the rounds that failed to function went through a hole produced by a previous round. Inspection of the two-layer bursting screen after the firing was completed, revealed that the rear layer had been badly damaged (17 rounds total had been fired against it). The inertia element of the fuze is designed to use nearly the entire impulse from impact with a 4-inch thick screen. It is possible, therefore, that the impacts on the damaged screen were not adequate to actuate the fuze system. Further tests are planned.

Table XVI is a copy of the firing record.

Test of DRA726 Nose Elements in T138E57 and T119E11 HEAT Projectiles

The programs proposed in the Thirtieth and Thirty-First Progress Reports, for the testing of DRA726 nose elements in HEAT rounds have been completed at Aberdeen Proving Ground. Table XVII is a summary of the results.

Of twenty-six fair hits on the armor plate (both normal and at 64° obliquity) twenty-five functioned properly. All eight T138E57 type projectiles functioned satisfactorily against both 2-inch and 4-inch wooden screens, but none of the six T119E11 projectiles fired against wooden screens functioned. Both the nose element and the nose of the T119E11 are being redesigned for increased sensitivity.

Future Program

1. Test T222E5 base elements in live loaded HEAT shell.

2. Evaluate the "inverted" firing system using 9GA20 No. 1 rectifiers and condensers in projectiles having burster charges.

3. Continue tests with T267E13 fuze base elements.

4. Continue tests with T223E2 fuzes.

Table XV
Firing Test Data
T267E13 Base Element

Muzzle — 67.08' — 1st Coil — 92.25' — 2nd Coil — 145 yds. — 4 Wooden Bursting Screen

Date March 20, 1953 Program Supp II T-267E13 Fuze Test

PROJECTILE
Model T-138
Type E-57A
Weight (Nominal) 17.30
C.G. Location
Bourrelet Dia (Nom.) 4.132 −.002
Special Features Band 360-6

Temperatures
Meq. Temps.
max. 70°F.
min. 70°F.
Pres. 70°F.
Loading Room 70°F.
Ambient 67°F.
Late Afternoon

TEST GUN
Model T131E3 #2
Type 105mm Recoilless
Length of Tube 105"
Twist of Rifling 1-200
Sighting Equipment M-17 Adapted Telescope
Bore Dia (Lands) 4.134 +.001

Tube 22B-775-B
Chamber 22B-353
V. Ring 22B-350-DA
Pendulum Mount

Pendulum Constant : 2.06 lbs.-sec/in.
Lanyard Fired Mechanical

MISCELLANEOUS DATA
Range 200 yds.
Propellant OAC 27A Primer T-3656 MOD
Type M10-MP web .0345 Charge Wt. 8lbs. 2oz.
T53E1 Cases
Proof Director J. Cheney
Observers Dr. V.E. Lucas W. Russell R. Barus R. McLean

Round No.		Liner Type	Proj. Weight (lbs.)	Fuze No	Recoil	Chamber Pressure * (psi)	Muzzle Velocity Instr.	Muzzle Velocity Actual	Powder Depth	Piezo Pressure Gage No.105	Chamber Inspection After Firing	Fuze	Type	Observations
4615	1	1-.113 sleeve 22B-373	17.34	6	3⅝ R	10,200 / 2,000	1590	1626	4⅛	——	A few slivers of propellant in chamber Bore Clean	T267E13	Superquick & Delay	Functioned Delay
4616	2	"	17.29	3	14½ R	8,700 / 8,800	1600	1628	4	——	Chamber and Bore clean.	"	Superquick & Delay	Functioned Superquick
4617	3		17.39	4	5⅝ R	9,600 / 9,800	1569	1597	4	11,100	Chamber and Bore clean	"	"	Functioned Delay
4618	4	"	17.29	1	13⅝ R	9,100 / 8,900	1576	1609	3⅞	——	Chamber and Bore clean.	"	"	Failed to Function
4619	5	"	17.30	5	3½ R	9,800 / 10,400	1605	1633	3⅞	——	Chamber and Bore Clean.	"	"	Failed To Function
4620	6	"	17.34	7	7⅛ R	10,000 / 9,000	1608	1636	3⅞	——	Chamber and Bore clean.	"	"	Functioned Delay
4621	7	"	17.30	2	13⅝ R	9,600 / 9,600	1603	1631	4⅛	12,050	Chamber and Bore clean.	"	"	Functioned Delay

All rounds were loaded and fired (with one waste rubber pad) as single units. Powder Depth taken after waste Rubber pad inserted.

* Internal M-3 (cu)

Signed O. Miller

Table XVI
Firing Test Data
T223E2 Mechanical Superquick and Delay Fuze

Rubber | 67.00' | 1st Coil | 28.25' | 2nd Coil | 145 yds. | 2" wooden Bursting Screen

Date March 24, 1953 Program Supp II T223 Fuze Test

PROJECTILE
Model T-138
Type E57A
Weight (Nominal) 17.30
C.G. Location ________
Bourrelet Dia.(Nom.) 4.132 -.002
Special Features Band 360-6

Temperatures
Mag. Temps.
Max. 70°F.
Min. 70°F.
Pres. 70°F.
Loading Room 70°F
Ambient 67°F
Late Afternoon

TEST GUN
Model T137E3 #2
Type 105 mm Recoilless
Length of Tube 105"
Twist of Rifling 1-200
Sighting Equipment M-17 Adapted Telescope
Bore Dia. (Lands) 4.134 +.001
Pendulum Constant = 2.06 lbs. - sec/in.
Lanyard fired Mechanical

Tube 228-715B
Chamber 228-355
V. Ring 228 350-DA
Pendulum Mount

MISCELLANEOUS DATA
Range 200 yds.
Propellant MC 27A Primer T-36E6 MCD
Type M1 MP web .0365 Charge Wt. 8 lbs. Rez. 733 E. Cases
Proof Director J. Cheney
Observers Dr. K.E. Lucas W. Russell
R. Barus R. McLean

Round No.	Liner Type	Proj Weight (lbs)	Fuze No.	Recoil	Chamber Pressure # (psi)	Muzzle Velocity Instr.	Muzzle Velocity Actual	Powder Depth	Piezo Pressure Gage No.105	Chamber Inspection After Firing	Fuze Type		Observations
4622	Laminated Type A	17.14	25	13" R	[illegible] 9,700	1604	1632	4"	5,800	Two Scraps of rayon ½" x 2" in case. Bore clean.	T-223		Failed to Function
4623	" A	17.14	21	6" R	9,700 8,500	1576	1604	4½"	—	Two scraps of rayon ½" x 1" in case. Chamber and Bore clean.	T-223	Delay	Functioned
4624	" B	17.20	23	7½" R	9,400 8,700	1572	1600	3¾"	12,250	Chamber and Bore Clean.	T-223	Delay	Functioned
4625	" B	17.22	26	11" R	9,500 9,500	1600	1628	3¾"	—	3 ½" x ½" Scrap in chamber Bore clean.	T-223		Not Observed
4626	" A	17.15	28	6½" R	9,700 8,500	1578	1606	4½"	9,000	½" x ½" Scrap in case 4 Small Scraps in Bore ½" x ½"	T-223		Missed Screen
4627	" A	16.91	22	12¾ R	9,660 9,800	1629	1657	4½"	9,700	3 Scraps ½" x 2 in case. ½" x ½" Scrap in bore.	T-223	Delay	Functioned
4628	" A	16.89	24	10¾" F	10,000 10,100	1621	1649	4½"	10,000	A small scrap in chamber Bore clean	T-223		Failed to Function
4629	" B	17.16	29	6" R	9,800 9,500	1589	1615	4½"	9,360	3 Scraps in case. ½" x 1" Two Small scraps in chamber.	T-223		Failed to Function
4630	" B	17.17	27	13¾" R	9,300 9,000	1608	1636	4½"	9,700	A very small scrap in tube. Chamber & Case clean.	T-223	Delay	Functioned
4631	" B	17.20	30	9¾" R	—	1596	1624	4½"	9,000	A 2" x ½" Scrap in Case 4 very small scraps in tube.	T-223	Delay	Functioned

Notes: All rounds were loaded and fired (with one white rubber pad) as single units.
Powder depth taken after white rubber pad inserted.
Round #4625 fired prematurely as chamber was closed. (No explanation)
Piezo Gage No.105 (Con. = 50/.01 μ coulomb) (Cap. = .032 μ farads)
Liners: DRC #79 (polyethylene & Rayon in separate sleeves.)
Laminate Type A. .473 oz. per sq. yd. rayon between sheets of 2 mil polyethylene.
Laminate " B. .460 " " " " " " " " "

Interval m/s (cu)

Signed O. Miller

Table XVII
Test Data
DRA726 Nose Element Tests

	Round No.	Target	Comments
Lot 12092 LE	72	2 in. Wood	Failed on wood, functioned down range.
Ti19	64	4 in. Wood	Missed target, no function down range.
DRA726	75	4 in. Wood	Missed target, functioned down range.
Nose	70	4 in. Wood	Failed on wood and down range.
Element	68	4 in. Wood	Wouldn't chamber.
	78	4 in. Wood	Failed on wood and down range.
	73	4 in. Wood	Failed on wood, functioned down range.
	63	4 in. Wood	Wouldn't chamber.
	66	4 in. Wood	Failed on wood, low order down range.
	73	4 in. Wood	Failed on wood and down range.
	74	6 in. 64° Armor	Functioned high order.
	77	6 in. 64° Armor	Functioned low order (nose did not hit)
	71	6 in. 64° Armor	Functioned high order.
	80	6 in. 64° Armor	Functioned high order.
	61	6 in. 64° Armor	Functioned high order.
	69	6 in. 64° Armor	Functioned high order.
	67	6 in. 64° Armor	Functioned high order.
	76	6 in. 64° Armor	Functioned high order.
Lot 12090	59	5 in. Vertical Armor	Misfire.
T138	29	5 in. Vertical Armor	Functioned high order.
DRA726	24	5 in. Vertical Armor	Functioned high order.
Nose	36	5 in. Vertical Armor	Functioned high order.
Element	27	5 in. Vertical Armor	Functioned high order.
	42	5 in. Vertical Armor	Functioned high order.
	51	4 in. Wood	Functioned high order.
	46	4 in. Wood	Functioned high order.
	21	4 in. Wood	Functioned high order.
	35	2 in. Wood	Functioned high order.
	28	6 in. 64° Armor	Wouldn't chamber.
	32	6 in. 64° Armor	Functioned high order.
	48	6 in. 64° Armor	Functioned high order.
	20	6 in. 64° Armor	Functioned high order.
	41	6 in. 64° Armor	Functioned high order.
	52	6 in. 64° Armor	Wouldn't chamber.
	16	6 in. 64° Armor	Functioned high order.
	31	6 in. 64° Armor	Wouldn't chamber.
	18	6 in. 64° Armor	Functioned high order.
	58	6 in. 64° Armor	Functioned high order.
	50	6 in. 64° Armor	Functioned high order.
	57	6 in. 64° Armor	Functioned high order.
	49	6 in. 64° Armor	Functioned high order.
	11	6 in. 64° Armor	Functioned high order.
	55	6 in. 64° Armor	Didn't fuuction.
	23	6 in. 64° Armor	Functioned high order.
	15	6 in. 64° Armor	Functioned high order.
	37	6 in. 64° Armor	Functioned high order.
	47	6 in. 64° Armor	Functioned high order.
	56	6 in. 64° Armor	Wouldn't chamber.
	22	6 in. 64° Armor	Functioned high order.
	25	6 in. 64° Armor	Functioned high order.
	60	6 in. 64° Armor	Functioned high order.
	53	6 in. 64° Armor	Functioned high order.

MANUFACTURING SUMMARY

In addition to the experimental materiel prepared for the research and development work under contracts DA-33-019-ORD-33 and DA-33-019-ORD-1202, described in preceding progress reports and in the preceding pages of this report, the following have been manufactured and shipped to the installations indicated. Firestone's Defense Research Division, in shipping these items, transfers custody and control of the items to the receiving agencies. However, personnel of Defense Research Division will continue to collaborate with personnel of the other installations in any evaluation or engineering tests involving these items.

I Cartridges, T119E11, Metal Parts Assembly, w/o Fuze T208E7

Prior to Mar. 1, 1953	355	(Live)	Picatinny Arsenal
Mar. 1, 1953	930	(Inert)	Picatinny Arsenal
Mar. 1, 1953	30	(Inert)	Aberdeen Proving Ground
Mar. 1, 1953	50	(Inert)	Frankford Arsenal
Mar. 5, 1953	300	(Inert)	Picatinny Arsenal
Mar. 12, 1953	300	(Live)	Picatinny Arsenal
Mar. 14, 1953	25	(Inert)	Aberdeen Proving Ground
Mar. 19, 1953	300	(Inert)	Picatinny Arsenal
Total to Mar. 31, 1953	2290		

II Rifles, T137E3, for ONTOS

Prior to Mar. 1, 1953	10	Ser. Nos. 3 to 11, 15	Allis-Chalmers
Mar. 6, 1953	4	Ser. Nos. 14, 16, 17, 20	Allis-Chalmers
Mar. 16, 1953	2	Ser. Nos. 12, 23	Allis-Chalmers
Mar. 25, 1953	2	Ser. Nos. 24, 25	Allis-Chalmers
Total to Mar. 31, 1953	18		
Balance on Order	4		

III Mounts, T152E4, for ONTOS

Prior to Mar. 1, 1953	6	Ser. Nos. 1 to 6	Allis-Chalmers
Mar. 6, 1953	2	Ser. Nos. 7, 8	Allis-Chalmers
Mar. 16, 1953	1	Ser. No. 9	Allis-Chalmers
Mar. 25, 1953	1	Ser. No. 11	Allis-Chalmers
Total to Mar. 31, 1953	10		
Balance on Order	2		

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